Appendix 2-F

Wild Horse Ridge
Soil Resource Inventory and Assessment

BEAR CANYON MINE
WILD HORSE RIDGE PORTAL PROJECT

Soil Resource Inventory and Assessment

Prepared for
C.W. Mining
P. O. Box 1245
Huntington, UT 84528

Prepared by:
Environmental Industrial Services
31 North Main
Helper, UT 84526

May 1999

DETAILED SOIL RESOURCE INVENTORY AND ASSESSMENT

BEAR CANYON MINE
WILD HORSE RIDGE PORTAL
EMERY COUNTY, UTAH

FOR
C. W. Mining Company

Environmental Industrial Services
31 North Main
Helper, Utah 84526

BY
Daniel M. Larsen
Professional Soil Scientist

May 1999

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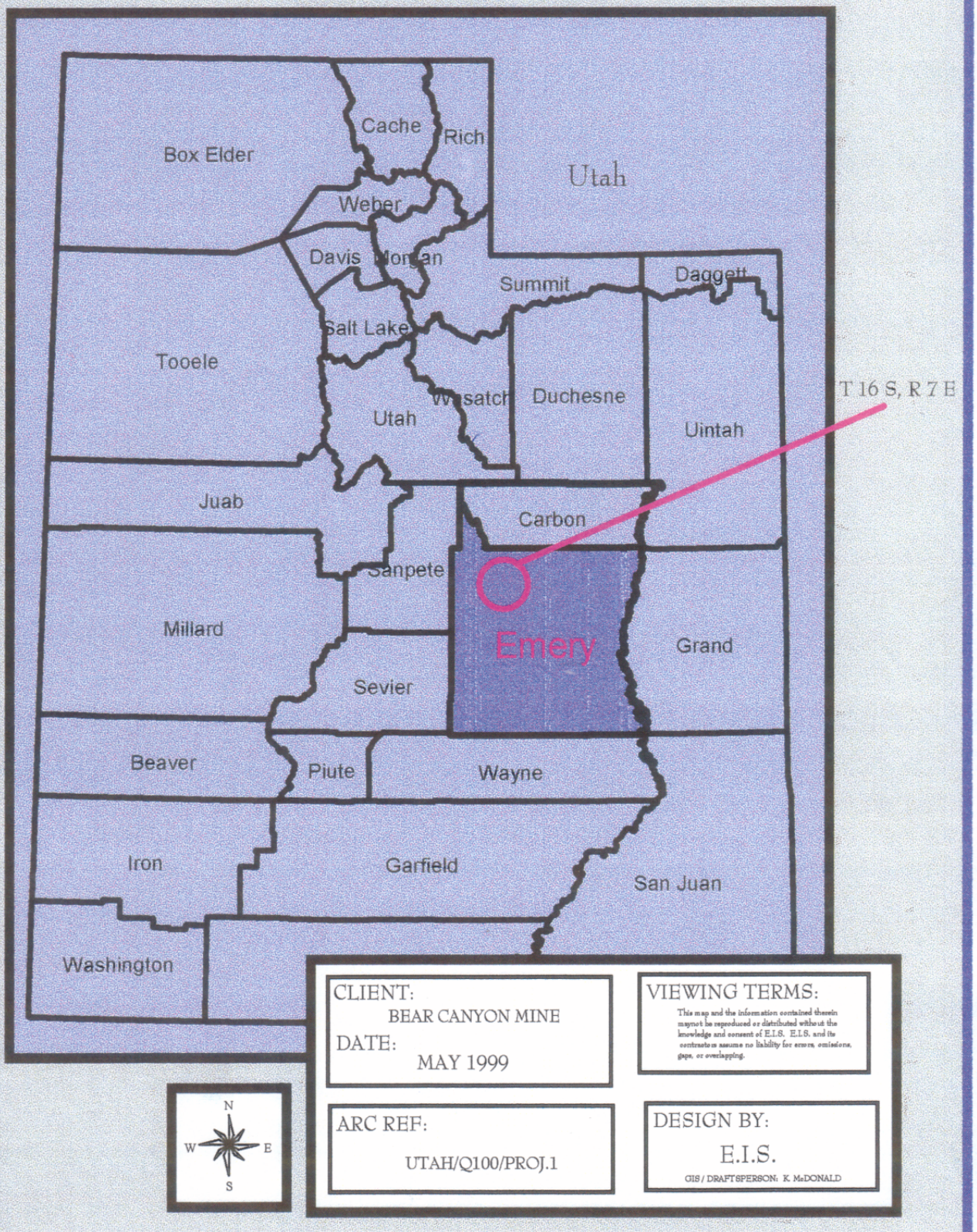
BEAR CANYON MINE

Wild Horse Ridge Portal Project

Emery County, Utah

Figure 1: Location Map



1.0 INTRODUCTION

1.1 LOCATION AND SETTING

This report presents soils information compiled from a detailed soil survey (order one intensity level) of the proposed Wild Horse Ridge Portal Project at the Bear Canyon Mine, Emery County, Utah. The study area is located about eight miles northwest of the town of Huntington; S24, T16S, R7E (Fig. 1). The project is an extension of the existing Bear Canyon Mine operated by C. W. Mining Company. It includes development of a portal site, conveyor, and access road. The main access road has been constructed, but may need upgrading. The total potential disturbed area is approximately six acres; which includes about one mile of road, 0.6 miles of conveyor corridor, and about 1.5 acres at the portal site.

The study area is located along the eastern edge of the Wasatch Plateau physiographic section. It is in a narrow, steeply sloping canyon cut in sandstone and shale bedrock at the south end of Gentry Mountain. The elevation ranges from about 7,130 to 7,710 feet, and annual precipitation is about 15 to 18 inches. Vegetation includes Pinion-juniper types of the more southerly facing slopes and Douglas-fir on the cooler north facing slopes.

1.2 OBJECTIVES

The detailed soil survey was conducted to provide sufficient information on the existing soil resources for the development and reclamation of the proposed portal, conveyor, and access road. The objectives were to document physical and chemical properties of the soils and assess soil suitability and limitations related to the proposed activities. One objective was to determine the amount of suitable soil materials available for reclamation purposes. This material sometimes referred to as topsoil, is the soil material which has properties that are suitable for growth of native plant species. Included in the soil survey are maps showing the distribution of different soil types and the thickness of salvageable soil materials, descriptions of the soils, soil laboratory test results, and photographs of soils and the landscape.

The information presented is to fulfill the soil survey and assessment requirements of the Utah Department of Natural Resources; Division of Oil, Gas, and Mining (UDOGM); pertaining to management of topsoil and overburden for mining.

2.0 METHODS AND PROCEDURES

2.1 DATA REVIEW AND EVALUATION

The project area had been mapped at the order two soil survey intensity level as part of a soil survey of the Bear Canyon Mine area by the USDA Natural Resources Conservation Service. This information was provided by Leland Sasser, Soil Scientist, NRCS, Price, Utah. Co-op Mining Company collected 14 soil samples from four different sites in the project area and submitted them to Inter-Mountain Laboratories, Farmington, New Mexico for analysis. This information base was fairly good; but more site specific documentation of soil descriptions, more detailed mapping, and further analysis was needed to meet the requirements of an order one (detailed) soil survey.

2.2 SOIL INVENTORY AND MAPPING

Soil inventory and mapping was conducted at the order one intensity level during April, 1999, by Daniel M. Larsen, Professional Soil Scientist. Field assistance was provided by Carl East, Biologist, E.I.S. Field mapping was done at a scale of one inch equal to 200 feet. Soil descriptions were obtained from hand dug soil pits and soils exposed on road cuts. Four of the soil descriptions were taken at the sites where Co-op Mining Company had taken soil samples for testing in 1996. Data collection consisted of a total of 25 points, as well as appropriate notes and photographs.

Documentation of field data is presented in Map B-Soil Data Collection Map; Appendix C-Field Soil Profile Descriptions and Transect Data; and Appendix D-Soil Profile and Landscape Photographs.

2.3 SOIL PROFILE (PEDON) DESCRIPTIONS

Soil profile descriptions, technically referred to as pedon descriptions, were recorded from a cleaned off representative section of the soil pit wall. Descriptions were taken on form SCS-Soils-232G and completed according to methods and standards of the National Cooperation Soil Survey as described in: the Soil Survey Manual (Soil Survey Staff, 1993); the National Soil Survey Handbook (Soil Survey Staff, 1993); and Keys to Soil Taxonomy, seventh edition (Soil Survey Staff, 1996).

The following parameters were described for each soil pedon description:

- horizon symbol, depth, thickness, and relative position;
- clarity and continuity of horizon boundaries;
- soil color (Munsell), both moist and dry;
- texture (fine earth fraction - <2mm);
- rock fragment content [type and size - (gravel - 2mm to 3"), (cobble - 3" to 10"), (stone - 10" to 2'), (boulder - >2'), and amount - % by volume];
- soil structure (type, size and grade);
- roots (size and abundance);
- clay films, if present (number, thickness, location);
- effervescence with 0.1N HC1 (none, slight, moderate, strong, violent);

In addition, the following soil and general site features were also described:

- existing dominant vegetation
- climate (moisture and temperature regimes)
- parent material
- physiography-landform
- relief
- elevation (obtainable from topographic maps)
- slope
- aspect
- erosion condition
- permeability

- drainage class
- depth to a saturated zone or ground water if encountered
- salts or alkali if present
- surface stoniness

2.4 SOIL SAMPLING AND LABORATORY ANALYSIS

Seven soil samples were selected during this inventory and submitted to Inter-Mountain Laboratories, Inc., Farmington, New Mexico, to supplement the data previously obtained by Co-op Mining Company. The samples were taken from representative soil layers and placed in clean plastic bags. About four to five pounds of each sample was sent to the laboratory on April 8, 1999. Laboratory testing results were received on May 5, 1999.

The following parameters were included in the soil analysis:

PH
Electrical conductivity
Saturation percentage
Sodium Absorption Ration
    includes Ca, Mg, and Na in meq/L
Mechanical Analysis
    includes % very fine sand, sand, silt, clay, and texture classification
Total Organic Carbon
    includes calculation for % organic matter
% Calcium carbonate
Boron ($CaCl_2$ extraction)
Selenium (AB-DPTA extraction)
Available water capacity
    includes 1/3 bar and 15 bar analyses
Exchangeable sodium percentage
    includes available Na, exchangeable Na, and cation exchange capacity. Analyzed only if SAR > 15 for sandy soils or >12 for clays

This list of parameters for testing was compiled through communications with Robert A. Davidson, Reclamation Soil Scientist, State of Utah, Department of Natural Resources, Division of Oil, Gas and Mining (August 1997). Mr. Davidson has also communicated with Inter-Mountain Laboratories, Inc., to assure that approved laboratory methods were used.

The 14 soil samples submitted by Co-op Mining Company in 1996, were tested for a slightly different array of parameters.

2.5 SOIL SUITABILITY FOR SALVAGE

Criteria to establish suitability of soil (topsoil) or soil substitute material were those contained in Table 2 of UDOGM "Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining," included as Appendix A. Although the UDOGM suitability criteria considers >30% (by volume) rock fragments (for both gravels <3" in size and cobbles 3 to 10" in size) to be unacceptable, and >10% stones and boulders >10" in size to also be unacceptable, recent discussion with Robert Davidson (Nyenhuis 1997) indicates his preference for salvaging soil with higher rock content. Although unacceptable thresholds were not set, the general idea is to salvage otherwise suitable soil with higher amounts of rock content in the soil than typical.

Potential salvage depths were determined for each map unit based on an evaluation of all of the field and laboratory data.

3.0 RESULTS AND DISCUSSION

3.1 SOIL SURVEY MAP

A detailed soil survey map was compiled at a scale of one inch equal 200 feet for the proposed Wild Horse Ridge Portal Project area. This map is shown as Map A. Seven soil map units were identified which represent areas having differences related to soil and landscape characteristics.

These soil map units are:

A. Pathead-Cabba Complex, 30 to 70% slopes

B. Winetti, High elevation; 5 to 30% slopes

C. Winetti, High elevation-Rock outcrop; 10 to 30% slopes

D. Doney, Deep; 10 to 30% slopes

E. Datino-Guben Complex, 30 to 80% slopes

F. Guben-Pathead Complex, 30-80% slopes

G. Doney-Cabba-Podo Complex, 30 to 80% slopes

These soil map units are specific to the project area and are slightly different than the units previously mapped by the Natural Resources Conservation Service at a broader level. Statements comparing the soil map units of these two inventories are given in Appendix F.

3.2 SOIL MAP UNIT DESCRIPTIONS

The seven soil map units identified in this inventory were given alphabetical symbols for simplicity. Map unit names are based on the dominant soil series present and steepness of the slopes. A soil series name is a name given to a soil that has a specific range of properties. Soil series descriptions for the soils common to this inventory are presented in Appendix E.

A general description of each of the soil map units is given below. In addition, soil map unit features are summarized in Table 3.2A.

Soil Map Unit A: Pathead-Cabba Complex 30 to 70% Slopes.

This soil map unit is on convex foot slopes supporting a Pinion-juniper vegetation type. Slope gradients are 30 to 70 percent. Soils have formed in stony colluvium and shale. They are well-drained and range from shallow to deep.

TABLE 3.2A-SOIL MAP UNIT FEATURES
WILD HORSE RIDGE PORTAL PROJECT

MAP UNIT	LAND FORMS	% SLOPE	PARENT MATERIAL	SOIL DEPTH	TEXTURES	ROCK FRAGMENT CLASS	GENERAL VEGETATION
A	Foothills	30-70%	Colluvium and Shale	Shallow to Deep	sl,l,cl	Stony to very cobbly	Pinion-Juniper
B	Narrow Canyon Bottoms	5-30%	Alluvium and Colluvium	Deep	sl,l,ls	Gravelly to Boulderly	Cottonwood Douglas-fir, Dogwood, Wildrose
C	Narrow Canyon Bottoms	5-30%	Alluvium, Colluvium and Sandstone	Shallow to Deep	sl,l,ls	Gravelly to Bouldery	Cottonwood Douglas-fir, Dogwood, Wildrose
D	Toeslope Slight Bench	10-30%	Colluvium, Slope Wash	Deep	sl,l,ls	Non-stony to stony	Ponderosa Pine, Juniper, Douglas-fir
E	Steep Canyon Slope, North Aspect	30-80%	Colluvium, and Shale	Moderate Deep to Deep	sl,l,cl	Very stony to non-stony	Douglas-fir Pinion, Mountain Mahogany, Serviceberry
F	Canyon Side Slope	30-80%	Colluvium, Sandstone, and Shale	Shallow to Moderate Deep	sl,l,cl	Very stony to bouldery	Douglas-fir Pinion, Mountain Mahogany
G	Steep Canyon Slope, South Aspect	30-80%	Sandstone, Shale, and Colluvium,	Shallow to Moderate Deep	sl,l,cl	Very stony to non-stony	Pinion, Juniper, Grass

The Pathead soils are weakly developed soils formed in stony colluvium derived dominantly from sandstone. Soil textures include sandy loam, loam, and clay loam. They are very cobbly to very stony. The surface layer in typically dark brown or dark grayish brown sandy loam about 3 to 4 inches thick. This is underlain by brown to yellowish-brown, very stony sandy loam to clay loam. Dept to bedrock is 20 inches or more.

The Cabba soils are shallow over shale. They are weakly developed and less than 20 inches to shale bedrock. The surface may have some gravelly or cobbly colluvium influence, but the soil profile is relatively stone free. Soil colors are dark grayish brown to dark brown and textures are loam and clay loam.

SOIL MAP UNIT B: WINETTI, HIGH ELEVATION, 5 TO 30% Slopes

This map unit is along the drainage bottom where soils have formed in alluvial and colluvial deposits derived from sandstone and shale. It occurs on a high gradient; ephemeral drainage system which lacks a well-defined bottom land. Vegetation is made up of a variety of species including Douglas-fir, Cottonwood, Ponderosa Pine, Dogwood, and Wild Rose.

Soils are mostly very gravelly to bouldery sandy loam or loam. They are similar to the Winetti soil series, which is typically at lower elevations with warmer temperatures. Sites in this canyon bottom are cool, and based on the vegetation are approaching a cryic temperature regime.

These soils are typically well-drained and have moderately rapid permeability. They show little soil profile development in the form of soil horizons. Topsoil layers are thin and subsoils are primarily a mixture of parent materials.

Included in the unit are segments of the existing access road and some side cast material from road construction.

SOIL MAP UNIT C: WINETTI HIGH ELEVATION-ROCK OUTCROP, 10 TO 30% SLOPES

This map unit occurs at the upper end of the drainage bottom in the project area. It consists of a narrow canyon bottom with steep side slopes. Rock outcrop is common, and in places the streambed is bedrock. Large boulders and stones are also common. This unit is similar to Soil Map Unit B, but is on a narrower and more rocky section along the drainage.

The soils are very gravelly to bouldery sandy loam, loam, and loamy sand. They range from shallow to deep and show little soil profile development. Only thin topsoil layers are present, with a mixture of material below.

SOIL MAP UNIT D: DONEY, DEEP; 10 TO 30% SLOPES

This map unit occurs on a small bench at the toe of a steep canyon slope. It is near the drainage bottom, but appears to have formed mostly from local slope wash and colluvium from the adjacent slopes. It is a gently sloping site compared to most of the project area and has deep soils supporting several large Ponderosa Pines trees. Field observations indicate that these soils are underlain by shale.

The soil in this map unit was grouped with the Doney soil family. Most of the unit appears to have soils that are deeper than 40 inches compared to the typical Doney family of 20 to 40 inches in depth.

Soils are brown to dark yellowish brown sandy loam and loam. The topsoil layer is thin and slightly darker colored than the remainder of the soil profile. Rock fragment content is less than 30 percent. The soils are well-drained and have moderate permeability.

SOIL MAP UNIT E: DATINO-GUBEN COMPLEX, 30 TO 80% SLOPE

This map unit occurs on a steep, north-facing canyon slope. Soil materials are primarily stony colluvium, although there are inclusions of shale where the colluvium is thin or lacking and also some mixed soil material that was side cast during road construction, Vegetation includes: Douglas-fir, Serviceberry, Curleaf Mountain Mahogany, and scatter Pinion and Juniper.

Soils include the Datino and Guben series and other similar soils. These soils have a high rock fragment content and a dark colored surface layer of about 6 to 8 inches in thickness. The Guben soils have a distinct calcium carbonate accumulation at about 20 to 30 inches. Other similar soils have the characteristics of the Datino and Guben soils, but the surface soil layer is slightly lighter in color.

The soils are well-drained and typically have textures of loam or sandy loam. They are typically deep and moderately permeable.

Included in this map unit are some soils that are less stony and are typically associated with shale where the colluvial deposits are thin or lacking. These soils account for less then 5 percent of the unit, but are contrasting to the dominant soils.

Material that was side cast from road construction consists of a soil that is typically a brown stony or very cobbly sandy loam of 1 to 3 feet in thickness over the original soil.

SOIL MAP UNIT F: GUBEN-PATHEAD COMPLEX, 30 TO 80% SLOPES

This map unit is on a steep, north-facing canyon side slope along the access road. It is up slope from Soil Map Unit E and has shallower soils with more sandstone bedrock present. Slopes are 30 to 80 percent in gradient. The soils have formed mostly in stony colluvial deposits which range from about 2 to 6 feet in thickness. Some sandstone rocks outcrop its present in the unit. Vegetation includes: Douglas-fir, Pinion Pine, Bristlecone Pine, Curleaf Mountain Mahogany, and Serviceberry.

The Guben soils typically have a dark colored surface layer (mollic) about 7 to 10 inches thick and a calcium carbonate accumulation at about 20 to 30 inches. They are very cobbly to very stony, with textures of sandy loam and loam. Soil depths are generally greater than 40 inches to bedrock.

The Pathead soils consist of moderately deep, weakly developed soils formed in very stony or cobbly colluvium and residual materials derived dominantly from sandstone. They have very thin topsoil layers and the parent materials are relatively unaltered by soil development processes. These soils are typically underlain by sandstone bedrock at 20 to 40 inches in depth.

Included in this map unit are about 10 percent Datino soils which are similar to Guben, but lack a calcic horizon.

SOIL MAP UNIT G: DONEY-CABBA-PODO COMPLEX, 30 TO 80% SLOPES

This soil map unit occurs on the steep, rocky, south-facing canyon slope near the proposed portal site. The soil components consist of shallow and moderately deep soils over sandstone and shale. The basic vegetation is a Pinion-juniper type.

The Doney soils are moderately deep (20 to 40 inches) and typically have less than 35 percent rock fragment content in the soil profile. They are well-drained and moderately permeable. Soil colors are typically dark brown and brown and textures are loam and sandy loam.

The Cabba soils are shallow (less than 20 inches) over shale bedrock. They typically have dark grayish brown and brown colors and textures of clay loam and loam. Permeability is restricted by the shallow depth to shale.

Podo soils are shallow over sandstone bedrock. They are typically loam or sandy loam in texture and are well-drained.

3.3 SOIL LABORATORY TESTING RESULTS

The soil laboratory testing results are shown in Appendix B. Included are the testing results from the samples submitted by Co-op Mining Company in 1996 (coded WHRS) and those from this field inventory (coded CW). The CW identification corresponds to this project under C. W. Mining Company.

A summary of the soil testing data is given below for twenty soil samples (excluding CW 10-1):

PARAMETER	RANGE	RATING*
pH	6.7 -- 7.8	Good
EC (mmhos/cm)	0.33 - 1.31	Good
Saturation %	30 — 49	Good
SAR	0.15– 0.7	Good
Texture	SCL,SI6,SL,L	Good
Boron (mg/Kg)	0.19– 1.6	Good
Selenium (mg/Kg)	<0.02	Good
CaCO3 % **	15.9– 26.4	Fair
Avail, Water Cap. (in/in)	0.06- 0.14	Fair to Good
Organic Matter % **	0.79- 2.6	Not Rated

*Rating based on soil suitability criteria, Table 2, Appendix A
**CW samples only

Soil tests indicate that the soils generally rate fair to good as material for reclamation. Only one soil sample showed notable variation from the others. Soil sample CW10-1 was taken from a light colored soil layer at about 20 to 30 inches in depth on a road cut in Soil Map Unit F. The sample was taken to document properties of a calcic horizon in a soil identified as Guben. Surprisingly, the soil test results indicated an unacceptable level of selenium and a poor rating for electrical conductivity (EC). The selenium level was reported at 0.26 mg/Kg which is over 100 times higher than all 20 of the other samples (all <0.02 mg/Kg). The sample was also higher in boron, calcium, magnesium, sodium, SAR and pH than other soil samples. The sample site is at the edge of the existing road accessing the portal site. It is not anticipated that this soil would be involved in disturbance needed for portal site development. Further assessment may be required if disturbances along this section of road is proposed.

There also appears to be an error in the percent organic matter in the samples submitted by Co-op Mining Company and coded WHRS. Results show all 14 samples having about 13 to 17 percent organic matter, which is unreasonably high.

3.4 SOIL SUITABILITY AND SALVAGE EVALUATION

Estimates of the amount of suitability soil material that could be salvaged for use in reclamation for each soil map unit based on the Utah Division of Oil, Gas, and Mining guidelines (Appendix A) are shown below:

SOIL MAP UNIT	SALVAGEABLE LAYER (INCHES		RESTRICTED BY
	Approximate Range	**Averages**	
A	8 to 15	12	Bedrock, stones
B	10 to 30	15	Stones
C	0 to 20	10	Bedrock, Boulder, Stones
D	30 to 60	40	Bedrock, Stones
E	20 to 40	30	Stones
F	0 to 30	10	Rock, Poor Soil, Chemical Properties
G	6 to 30	15	Bedrock, Stones, Boulders

The soils in the project area are extremely complex making it difficult to identify uniform soil layer to salvage. Approximate ranges and averages are given, but actual field operations will be dictated by practical judgement.

REFERENCES

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Leatherwood, James and Dan Duce, 1986. Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining. State of Utah Department of Natural Resources, Division of Oil, Gas and Mining. Salt Lake City, Utah.

Sasser, Leland, 1996. Soil Survey of the Bear Canyon Mine Area, Utah. USDA, Natural Resource Conservation Service.

Stokes, William L., 1986. Geology of Utah. Utah Museum of Natural History, University of Utah and Utah Geological and Mineral Survey, Department of Natural Resources. Occasional Paper Number 6 of the Utah Museum of Natural History. Salt Lake City, Utah.

APPENDIX A

SOIL SUITABILITY CRITERIA

Soil Suitability Criteria

UDOGM: Overburden Evaluation for Vegetative Root Zone; Table 2 (Leatherwood and Duce 1988)

Parameters	Good	Fair	Poor	Unacceptable
pH	6.1 - 8.2	5.1 - 6.1 8.2 - 8.4	4.5 - 5.0 8.5 - 9.0	less than 4.5 greater than 9.0
Ec mmhos/cm 25°C	0 - 2	2 - 8	8 -15	greater than 15
Saturation %	25% - 80%		less than 25% greater than 80%	
Texture	sl, l, sil, scl, vfsl, fsl	cl, sicl, sc, ls, lfs	sic, s, sc, c, cos, fs, vfs	g, vcos
SAR	0 - 4	5 - 10	10 - 12 Fine Texture 10 - 15 Coarse Texture	12 Fine Texture 15 Coarse Texture
Selenium	less than 0.1 mg/Kg			greater than 0.1 mg/Kg
Boron	less than 5.0 mg/Kg			greater than 5.0 mg/Kg
Acid/Base Potential	greater than -5 tons $CaCO_3$ 1,000 tons material			less than -5 tons $CaCO_3$ 1,000 tons material
% Coal fines	Undetermined at this time			
Available water capacity (in/in)	greater than 0.10	0.05 - 0.10	less than 0.05	
Rock Fragments (% volumes) 3 Inches 3 - 10 Inches 10 Inches	 0 - 15 0 - 15 0 - 3	 15 - 25 15 - 25 3 - 7	 25 - 30 25 - 30 7 - 10	 greater than 30 greater than 30 greater than 10

APPENDIX B

SOIL LABORATORY TESTING RESULTS

BEAR CANYON MINE
WILD HORSE RIDGE PORTAL PROJECT

SOIL SAMPLE I. D. EXPLANATION

WHRS-1 is a site in Pinion-Juniper in Soil Map Unit A. It corresponds to soil profile description CW-6. (Pathead)

WHRS-2 is near some large ponderosa pines in Soil Map Unit D. It corresponds to soil profile description CW-5. (Doney, deep)

WHRS-3 is along the drainage in Soil Map Unit C. It corresponds to soil profile description CW-4. (Winetti)

WHRS-4 is on the north-facing slope near the portal site in Soil Map Unit E. It is near soil profile description CW-1.

CW3-1 is a Doney soil in Soil Map Unit G. It is identified in soil profile description CW-3.

CW5-1 and CW5-2 are from the same site as WHRS-2. These two samples were at greater depths than previously sampled. The site is identified by soil profile description CW-5.

CW8-1 and CW8-2 are from a shallow soil over shale (Cabba) in Soil Map Unit A.

CW9-1 is mixed soil from side cast material along the road in Soil Map Unit E.

CW10-1 was taken on a road cut in Soil Map Unit F. The soil layer appeared to be a light colored calcic horizon in a Guben soil.

Intermountain Laboratories, Inc.
2506 West Main Street
Farmington, NM 87401
ATTN: Eric Jaquez, Soil Laboratory Supervisor

April 9, 1999

Dear Mr. Jaquez:

We are sending seven soil samples for testing as noted on the enclosed record form. These soil samples were taken from an area proposed for coal mine portal development by C.W. Mining Company at the Bear Canyon Mine near Huntington, Utah. EIS is conducting a detailed soil survey and assessment for the project.

We request that the billing be made to: C.W. Mining Company; P.O. Box 1245 Huntington, Utah 84528. Estimated charges are $130 to $160 per sample, depending on the need to determine ESP. If you have any questions or comments, please contact Dan Larsen, Soil Scientist for EIS at (435) 472-3814. Thank you for your services.

Sincerely,

Melvin A. Coonrod
Owner, EIS Environmental Industrial Service

cc: Charles Reynolds, P.E.
C.W. Mining Company
P.O. Box 1245
Huntington, Utah 84528

imi
Inter- Mountain
Laboratories, Inc.

CHAIN OF CUSTODY RECORD

Client/Project Name	Project Location	ANALYSES / PARAMETERS
EIS / C.W. Mining Co.	Emery Co., Utah Bear Canyon Mine - Wildhorse Portal	
Sampler: (Signature) Daniel M. Larsen	Chain of Custody Tape No.	

Sample No./ Identification	Date	Depth (Inches) ~~Time~~	Lab Number	Matrix	No. of Containers	Remarks
						ANALYZE FOR:
CW 3-1	4/8/99	0-30		Soil Testing		pH, EC, SAT %
CW 5-1	4/8/99	36-50				Ca, Mg, Na, SAR,
CW 5-2	4/8/99	50-70				MAC (S, Si, C, VFS)
CW 8-1	4/8/99	0-6				$CaCO_3$ %, Boron,
CW 8-2	4/8/99	6-12				Se (AB-DTPA), TOC,
CW 9-1	4/8/99	5-30				%OM, ESP CIF SAR
CW 10-1	4/8/99	20-30				>15 for sandy soils or
						>12 for clays), 1/3 bar
						and 15 bar water %

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
	4/8/99	1200			
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by laboratory: (Signature)	Date	Time
			Eric Sague	4/12	

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2506 West Main Street, Farmington, NM 87401

May 5, 1999

Mr. Dan Larsen
ENVIRONMENTAL INDUSTRIAL SERVICES
31 North Main Street
Helper, Utah 84526

Dear Mr. Larsen:

Enclosed are the results of the analyses performed on the soil samples received by IML on April 13, 1999. The samples were labeled Bear Canyon Mine – Wildhorse Portal, and correspond to IML lab numbers 0399S01926 - 32. The requested analyses for each were pH, electrical conductivity, saturation percentage, sodium absorption ratio, mechanical analysis (including analysis of very fine sand), % calcium carbonate, soluble boron, selenium (AB-DTPA), total organic carbon, % organic matter, 1/3 bar water, 15 bar water, and exchangeable sodium percentage for sample with an SAR >15 for sandy soils or >12 for clays.

If you have any questions or comments, please feel free to contact me at 1-800-828-1409.

Sincerely,

Eric J Jaquez
Soil Lab Supervisor
IML - Farmington, NM

enclosure: analytical report

Inter-Mountain Laboratories, Inc.

2506 West Main Street | Farmington, New Mexico 87401 | Tel. (505) 326-4737

Environmental Industrial Services (EIS)

Client Project ID: Bear Canyon Mine | Helper, UT | IML Project #0399S01926

Date Received: 04/13/99 | Bear Canyon Mine - Wildhorse Portal | Report Date: 05/05/99

Lab Id	Sample Id	Depths	pH	EC	Saturation	Ca	Mg	Na	SAR	Sand	Silt	Clay	Texture USDA	Very Fine Sand
		Inch	s.u.	mmhos/cm	%	meq/L	meq/L	meq/L		%	%	%		%
0399S01926	CW 3-1	0 - 30	7.8	0.64	35	2.8	4.1	1.2	0.7	53	31	16	SL	15
0399S01927	CW 5-1	36 - 50	7.6	0.37	32	2.4	1.6	0.43	0.3	53	35	12	SL	26
0399S01928	CW 5-2	50 - 70	7.8	0.40	30	1.9	2.7	0.63	0.4	51	37	12	L	25
0399S01929	CW 8-1	0 - 6	7.5	0.37	42	3.2	0.84	0.51	0.4	25	51	24	SIL	17
0399S01930	CW 8-2	6 - 12	7.6	0.33	48	2.2	1.0	0.44	0.3	21	55	24	SIL	16
0399S01931	CW 9-1	5 - 30	7.4	0.63	37	5.3	2.7	0.80	0.4	61	25	14	SL	14
0399S01932	CW 10-1	20 - 30	8.3	10.2	38	7.5	160	35	3.7	43	35	22	L	17

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2506 West Main Street | Farmington, New Mexico 87401 | Tel. (505) 326-4737

Environmental Industrial Services (EIS)

Client Project ID: Bear Canyon Mine | Helper, UT | IML Project #0399S01926

Date Received: 04/13/99 | Bear Canyon Mine - Wildhorse Portal | Report Date: 05/05/99

Lab Id	Sample Id	Depths	Boron Soluble	Selenium AB_DTPA	CaCO3	TOC	Organic Matter	1/3 Bar Water	15 Bar Water
		Inch	mg/Kg	mg/Kg	%	%	%	%	%
0399S01926	CW 3-1	0 - 30	1.6	<0.02	15.9	0.95	1.6	16	9
0399S01927	CW 5-1	36 - 50	0.5	<0.02	18.0	0.46	0.79	12	6
0399S01928	CW 5-2	50 - 70	0.6	<0.02	19.2	0.32	0.55	13	6
0399S01929	CW 8-1	0 - 6	0.9	<0.02	19.6	0.76	1.3	16	10
0399S01930	CW 8-2	6 - 12	0.6	<0.02	17.6	0.54	0.93	17	11
0399S01931	CW 9-1	5 - 30	1.0	<0.02	26.4	1.5	2.6	18	8
0399S01932	CW 10-1	20 - 30	2.5	0.26	28.3	0.64	1.1	18	7

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Environmental Industrial Services (EIS)

Client Project ID: Bear Canyon Mine | Helper, UT | IML Project #0399S01926

Date Received: 04/13/99 | Bear Canyon Mine - Wildhorse Portal | Report Date: 05/05/99

Lab Id	Sample Id	Depths	pH	EC	Saturation	Ca	Mg	Na	SAR	Sand	Silt	Clay	Texture USDA	Very Fine Sand
		Inch	s.u.	mmhos/cm	%	meq/L	meq/L	meq/L		%	%	%		%
0399S01931	CW 9-1	5 - 30	7.4	0.63	37	5.3	2.7	0.80	0.4	61	25	14	SL	14
0399S01931D	CW 9-1	5 - 30	7.4	0.64	37	5.2	2.7	0.78	0.4	61	25	14	SL	14

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Environmental Industrial Services (EIS)

Client Project ID: Bear Canyon Mine | Helper, UT | IML Project #0399S01926

Date Received: 04/13/99 | Bear Canyon Mine - Wildhorse Portal | Report Date: 05/05/99

Lab Id	Sample Id	Depths	Boron Soluble	Selenium AB_DTPA	CaCO3	TOC	Organic Matter	1/3 Bar Water	15 Bar Water
		Inch	mg/Kg	mg/Kg	%	%	%	%	%
0399S01931	CW 9-1	5 - 30	1.0	<0.02	26.4	1.5	2.6	18	8
0399S01931D	CW 9-1	5 - 30	1.0	<0.02	25.8	1.6	2.7	17	8

B.C.
8A-18
9/31/98

Inter-Mountain Laboratories, Inc.
2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

Co-op Mining Company
Huntington, UT
MINE: Bear Canyon
LOCATION: Bear Canyon Mine

DATE SAMPLED: August 14, 1996
DATE REPORTED: November 4, 1996

Lab No.	Location	Depths Inches	pH	EC mmhos/cm @ 25°C	Saturation %	Calcium meq/l	Magnesium meq/l	Sodium meq/l	SAR	Coarse Fragments %	Sand %	Silt %	Clay %	Texture
49139	WMRS-1	0.0-6.0	7.0	0.88	45.7	3.13	1.18	0.35	0.15	20.6	50.0	27.0	23.0	SANDY CLAY LOAM
49140		6.0-12.0	7.1	0.75	42.5	3.32	1.07	0.42	0.21	33.3	42.0	33.0	25.0	LOAM
49141		12.0-24.0	7.1	0.69	34.7	3.39	1.06	0.46	0.22	35.9	46.0	29.0	25.0	LOAM
49142	WMRS-2	0.0-6.0	6.9	0.72	33.6	3.28	1.53	0.30	0.15	18.2	49.0	38.0	13.0	LOAM
49143		6.0-12.0	7.0	1.07	37.4	9.11	2.59	0.38	0.15	21.4	46.0	39.0	15.0	LOAM
49144		12.0-24.0	7.2	0.79	31.4	6.37	2.26	0.41	0.20	34.3	50.0	33.0	17.0	LOAM
49145		24.0-36.0	7.1	0.53	30.9	3.72	1.67	0.38	0.23	33.6	46.0	39.0	15.0	LOAM
49146	WMRS-3	0.0-6.0	6.7	1.13	34.9	9.97	3.04	0.48	0.18	68.5	64.0	21.0	15.0	SANDY LOAM
49148		6.0-12.0	7.3	0.62	34.0	4.89	2.24	0.39	0.21	52.3	56.0	25.0	19.0	SANDY LOAM
49149		12.0-24.0	7.3	1.14	49.0	8.88	6.74	0.55	0.20	17.9	52.0	29.0	19.0	SANDY LOAM
49150		24.0-36.0	7.2	1.26	44.6	9.59	7.93	0.86	0.29	8.0	54.0	25.0	21.0	SANDY CLAY LOAM
49151	WMRS-4	0.0-6.0	7.2	0.65	34.8	5.20	2.39	0.32	0.16	85.2	54.0	27.0	19.0	SANDY LOAM
49152		6.0-12.0	6.7	1.31	35.4	11.5	4.41	0.53	0.19	56.5	66.0	19.0	15.0	SANDY LOAM
49153		12.0-24.0	7.5	0.63	30.7	3.88	3.31	0.58	0.31	48.6	55.0	26.0	19.0	SANDY LOAM

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage, Exch= Exchangeable, Avail= Available

B.C.
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Inter-Mountain Laboratories, Inc.
2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

CO-OP MINING COMPANY
Huntington, UT
MINE: Bear Canyon
LOCATION: Bear Canyon Mine

DATE REPORTED: August 29, 1996
DATE RECEIVED: November 4, 1996

Lab No.	Location	Depths inches	Organic Matter %	Total Sulfur %	T.S. AB t/1000t	Neut. Pot.	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	PyrS AB t/1000t	PyrS ABP t/1000t
49139	WHRS-1	0.0-6.0	15.9	-0.01	0.05	153.					
49140		6.0-12.0	15.8	-0.01	0.05	174.					
49141		12.0-24.0	14.0	-0.01	0.05	196.					
49142	WHRS-2	0.0-6.0	14.3	-0.01	0.07	196.					
49143		6.0-12.0	13.5	-0.01	0.07	114.					
49144		12.0-24.0	17.9	0.01	0.45	85.7					
49145		24.0-36.0	13.0	-0.01	0.05	77.5					
49146	WHRS-3	0.0-6.0	15.2	0.02	0.54	135.					
49148		6.0-12.0	13.2	-0.01	0.09	125.					
49149		12.0-24.0	15.9	0.02	0.49	58.8					
49150		24.0-36.0	15.0	0.02	0.49	47.5					
49151	WHRS-4	0.0-6.0	13.2	-0.01	0.03	113.					
49152		6.0-12.0	15.0	-0.01	0.04	127.					
49153		12.0-24.0	13.7	-0.01	0.08	125.					

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential

B.C.
8A-20
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Inter-Mountain Laboratories, Inc.
2506 West Main Street
Farmington, New Mexico 87401
Tel. (505) 326-4737

CO-OP MINING COMPANY
Huntington, UT
MINE: Deer Canyon
LOCATION: Deer Canyon Mine

DATE SAMPLED: August 21, 1996
DATE RECEIVED: November 4, 1996

Lab No.	Location	Depths inches	Nitrate-Nitrogen ppm	Boron ppm	Bulk Density	Total Kjeldahl Nitrogen	1/3 bar	15 bar	H2O Sol Selenium ppm
49139	WHRS-1	0.0-6.0	<0.01	0.42	1.77	0.19	23.4	14.0	<0.02
49140		6.0-12.0	<0.01	0.32	2.16	0.14	22.4	12.0	<0.02
49141		12.0-24.0	<0.01	0.27	2.20	0.11	20.0	7.4	<0.02
49142	WHRS-2	0.0-6.0	<0.01	0.25	1.78	0.16	16.4	5.2	<0.02
49143		6.0-12.0	<0.01	0.34	1.60	0.18	13.0	7.0	<0.02
49144		12.0-24.0	<0.01	0.19	2.10	0.08	17.0	5.0	<0.02
49145		24.0-36.0	<0.01	0.23	1.52	0.09	19.0	5.0	<0.02
49146	WHRS-3	0.0-6.0	<0.01	0.51	2.00	0.14	16.0	8.0	<0.02
49147		6.0-12.0	<0.01	0.29	2.20	0.10	13.1	7.2	<0.02
49148		12.0-24.0	<0.01	0.65	1.40	0.22	27.0	14.4	<0.02
49149		24.0-36.0	<0.01	0.63	1.39	0.25	24.4	12.4	<0.02
49151	WHRS-4	0.0-6.0	<0.01	0.39	1.80	0.09	17.5	8.5	<0.02
49152		6.0-12.0	<0.01	0.49	1.70	0.12	19.0	8.8	<0.02
49153		12.0-24.0	<0.01	0.41	2.50	0.07	20.7	6.4	<0.02

Abbreviations for extractants: SP= Saturated Paste Extract, H2OSol= water soluble, ABDTA= Ammonium Bicarbonate-DPTA, AAO= Acid Ammonium Oxalate

APPENDIX C

FIELD SOIL PROFILE DESCRIPTIONS AND TRANSECT DATA

SOIL PROFILE DESCRIPTIONS FOOTNOTES

[1] Soil Series, and Soil Classification according to current NRCS information. Soil classification based on Keys to Soil Taxonomy, 7th edition (Soil Survey Staff 1996).

[2] Horizon and Depth based on site-specific conditions at the sample location.

[3] Texture and texture modifier abbreviations:

S	Sand	SCL	Sandy Clay Loam	CB	Cobbly	GR	Gravely
LS	Loamy Sand	CL	Clay Loam	CBV	Very Cobbly	GRV	Very Gravely
SL	Sandy Loam	SICL	Silty Clay Loam	CBX	Extremely Cobbly	GRX	Extremely Gravely
L	Loam	SIC	Silty Clay	CN	Channery	SH	Shaley
SIL	Silt Loam	C	Clay	CNV	Very Channery	SR	Stratified
SI	Silt			CNX	Extremely Channery		

[4] Color, Dry and Moist: Munsell Soil Color Chart, 1994 Edition.

[5] Structure:

Grade	Size	Type
W Weak	VF Very Fine	PL Platy
M Moderate	F Fine	GR Granular
S Strong	M Medium	SBK Subangular Blocky
	CO Coarse	ABK Angular Blocky
	VCO Very Coarse	PR Prismatic
		W Massive Weak Massive
		Massive
		S Massive Strong Massive
		SG Single Grained
		Cloddy

[6] Consistency:

Dry		Moist		Wet	
LO	Loose	LO	Loose	NS	Non Sticky
SO	Soft	VFR	Very Friable	SS	Slightly Sticky
SH	Slightly Hard	FR	Friable	S	Sticky
H	Hard	FI	Firm	VS	Very Sticky
VH	Very Hard	VFI	Very Firm	NP	Non Plastic
EH	Extremely Hard	EFI	Extremely Firm	SP	Slightly Plastic
				P	Plastic
				VP	Very Plastic

[7] Roots:

Number	Type	
Very Few	VF	Very Fine
Few	F	Fine
Com (Common)	M	Medium
Many	CO	Coarse

Roots are described in terms of a specified size (type) and quantity (number). The size classes are:

Very Fine: Less than 1 mm in diameter
Fine: 1 to 2 mm in diameter
Medium: 2 to 5 mm in diameter
Coarse: 5 mm or larger in diameter
Roots larger than 10 mm in diameter may be described separately.

Quantity classes or roots are defined in terms of numbers of each size per unit area–1 square centimeter for very fine and fine roots, and 1 square decimeter for medium and coarse roots. All roots smaller than 10 mm in diameter are described in terms of the following quantity classes:

Few: Less than 1 per unit area of the specified size
Common: 1 to 5 per unit area of the specified size
Many: More than 5 per unit area of the specified size
Roots are described as to number first, and type second.

[8] Rock Fragments: All rock fragment percentages (% by volume) are taken from the field soil profile descriptions. Geologic modifier types (gravelly, channery, etc.) are also taken from the field soil profile description forms for each sampled profile.

[9] Reaction: Effervescence

EO	Non-Effervescent
SE	Slightly Effervescent
EM	Moderately Effervescent
ES	Strongly Effervescent
EV	Violently Effervescent

Reaction		pH
Str. Acid	Strongly Acid	5.1 - 5.5
Mod. Acid	Moderately Acid	5.6 - 6.0
Sl. Acid	Slightly Acid	6.1 - 6.5
Neutral	Neutral	6.6 - 7.3
Mild. Alk.	Mildly Alkaline	7.4 - 7.8
Mod. Alk.	Moderately Alkaline	7.9 - 8.4
Strong Alk.	Strongly Alkaline	8.5 - 9.0
Very Strong Alk.	Very Strongly Alkaline	>9.0

[10] Horizon Boundaries:

Distinctness

A	Abrupt (<2 cm thick)
C	Clear (2 to 5 cm thick)
G	Gradual (5 to 15 cm thick)
D	Diffuse (>15 cm thick)

Topography

S	Smooth (the boundary is a plane with few or no irregularities)
W	Wavy (the boundary has undulations in which depressions are wider than they are deep)
I	Irregular (the boundary has pockets that are deeper than they are wide)
B	Broken (at least one of the horizons or layers separated by the boundary is discontinuous and the boundary is interrupted).

SCS-SOILS-232G
REV. 12-70
FILE CODE SOILS-11

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

Soil type Disturbed site, slope side cast over Guben - like soil — File No. CW-1

Area Co-op Mine, Wildhorse Ridge Portal Proj. S24, T16S, R7E Emery Co., UT — Date 4-1-99 D. Larsen C. East — Stop No. 1

Classification Loamy-skeletal, mixed, frigid Typic Ustorthent (disturbed soil)

Location Near portal site, fill slope (side cast) below road clearing, east side of canyon

N. veg. (or crop) Douglas-fir, curleaf mountain mahogany — Climate Ustic, frigid

Parent material Sandstone and shale

Physiography Steep canyon slope

Relief V. steep, single slope	Drainage Well drained	Salt or alkali
Elevation 7660 feet	Gr. water	Stoniness V. stony
Slope 90%	Moisture Profile moist throughout	
Aspect NW	Root distrib. Well distributed	% Clay * 25
Erosion Slight	% Coarse fragments * 40 - 50	% Coarser than V.F.S. *

Permeability Mod.

Additional notes

Site of Co-op Mine soil sampling of 8/21/96

WHAS-1 Lab. No. 49139, 49140, 49141 (0-6, 6-12, 12-24")

Extremely bouldery at Toe of slope below

Fill material over a 1-sk Calciborall like Guben or a Calcic Ustochrept

GROUND COVER (%)	RANGE	AVERAGE
Gravel 2MM-3"		10
Cobble 3-10"		20
Stone 10-24"		20
Boulder >24"		17
Vegetation Good grass recovery		8
Litter		20
Bare		5

* Control section average

Horizon	Depth inches	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	pH Reaction	Boundary	% Rock Fragments	Root Distribution	
AC1	0-6		10YR 4/3	STV SCL-L	WFGR	SO	FR	SS/SP	es	GW	25 G 10 C 10 S	m-cfm	
AC2	6-31		10YR 4/3	L	WFGR	SO	FR	SS/SP	es	GW	20 G 10 C 10 S	cfm	
2AO	31-35	Highly organic, Mixed soil and woody material	10YR 4/4	L	WFGR	SO	FR	SS/SP	es	CW	"	cfm	Appears to be original surface
2BK	35-45+	10YR 6/3 - 7/3	10YR 5/3	L	OM-WFGR	SH	FI	SS/SP	ev		"	ffm	

SCS-SOILS-232G
REV. 12-70
FILE CODE SOILS-11

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

Soil type Pathead — File No. CW-2

Area Co-op Mine Wildhorse Ridge Portal Proj. Emery Co, UT — Date 4/1/79 D.LARSEN C.EAST — Stop No. 2

Classification Loamy-skeletal, mixed, Frigid Typic Ustorthent

Location Near portal site on S. facing slope — S24, T16S, R7E

N. veg. (or crop) Pinyon-juniper, serviceberry, Salina wildrye — Climate Frigid, Ustic

Parent material Sandstone and shale + colluvium

Physiography Canyon side slope, near toe

Relief V. steep, simple — Drainage Well drained — Salt or alkali —

Elevation 7640 — Gr. water — — Stoniness V. stony

Slope 60↑ 75↓ ≈65% — Moisture Profile moist throughout

Aspect SSE — Root distrib. Well distributed — % Clay * 20

Erosion Mod. to severe, soil creep — % Coarse fragments * 50 — % Coarser than V.F.S. * —

Permeability Mod.

Additional notes

The upper 24" is primarily soil from sandstone colluvium. At 24 inches to 36 inches is a shaly zone. 36" may be bedrock or a large stone. Bed rock surfaces about 20 feet down slope and at about 50 feet up slope. Lithic soils cover about 5 to 10 percent of the unit.

Mod. Deep

GROUND COVER (%)	RANGE	AVERAGE
Gravel 2MM-3"		10
Cobble 3-10"		20
Stone 10-24"		25
Boulder >24"		15
Vegetation		5
Litter		5
Bare		20

* Control section average

Horizon	Depth inches	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	pH Reaction	Boundary	% Rock Fragments	Root Distribution
A1	0-4	10YR 6/2	10YR 4/2	Loam	WFGR	LO-SO	VFR	SS SP	8.0 ES	CW	30G 15C 15S	MF
BW1	4-12	7.5YR 6/4	7.5YR 4/4 *	Loam	WFGR	SO	VFR	SS SP	8.0 ES	GW	25G 10C 15S	CFM
BW2	12-24		10YR 4/2-4/3	Loam	WMSBK	SH	FR	SS SP	8P ES	CW	25G 10C 15S	CFM
2C	24-36		10YR 4/1	CL	WFSBK + MTNPL	SH	FI	S P	8.0 ES		15G 10C	CF FM
R	36+	Sandstone									R	

* The slightly redder color appears to be related to parent material rather than pedogenic

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FILE CODE SOILS-11

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

Soil type Doney ? SS or shale bedrock — File No. CW-3

Area CO-OP Mine, Wildhorse Canyon Portal Proj. S24, T16S, R7E Emery Co., UT — Date 4/1/99 D. LARSEN C. EAST — Stop No. 3

Classification Fine-loamy, mixed, Frigid, Typic Ustorthent

Location Just above first road crossing below portal ≈ 400' below portal — N 393,400 E 2,117,300

N. veg. (or crop) Grass (Sandwort), P-J (few), D.-Fir (few) — Climate Frigid, Ustic

Parent material Colluvium from sandstone and shale

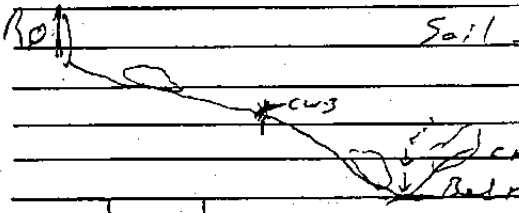
Physiography Toe slope of canyon, slight bench

Relief Steep	Drainage Well	Salt or alkali —
Elevation 7420	Gr. water —	Stoniness Very stony & Bouldery
Slope 45 - 70%	Moisture Profile moist throughout	
Aspect E.	Root distrib. Well distributed	% Clay * ≈ 20
Erosion mod.	% Coarse fragments * 12 - 40 Ave ≈ 35 in profile	% Coarser than V.F.S. *

Permeability Mod.

Additional notes Shale is exposed in the road cut just below. This site is a similar slope position, sandstone rock outcrop above. AC has mixed sandstone and shale fragments.

Soil Samples Taken



GROUND COVER (%)	RANGE	AVERAGE *
Gravel 2MM-3"		15
Cobble 3-10"		5
Stone 10-24"		20
Boulder >24"		15
Vegetation		15
Litter		20
Bare		10

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	pH Reaction	Boundary	% Rock Fragments	Root Distribution		
A1	0-3	10YR 5/2	10YR 3/2	Loam	MVFGR	SO	VFR	SS SP	≈8.0 ES	CW	15G 5C 5S	MFM		
A2	3-13	10YR 5/3	10YR 4/2	Loam	WMGR	SO	FR	SS SP	ES	gW	5G 2C 5S	MFM		
A3	13-31	10YR 5/3	10YR 4/2	L-CL	WFSBK	SH	FR	S P	ES	CW	5G 2C 5S	MFM		
AC	31-34		10YR 4/3 70% 10YR 5/2 30%	CL	WFSBK	SH	FI	S P	ES		5G 5C 30S	CFM		
R	34+	? Bedrock or boulder			Shale is nearby									

SCS-SOILS-232G
REV. 12-70
FILE CODE SOILS-11

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

Soil type Winetti, High elev. File No. CW-4

Area Co-op Mine, Wildhorse Ridge Portal Proj. Emery Co., UT Date 4/1/99 D. LARSEN C. EAST Stop No. 4

Classification Loamy-skeletal, mixed, Frigid, Typic Ustifluvent

Location Along drainage 300 feet below portal site S24, T16S, R7E

N. veg. (or crop) Douglas-fir Climate Frigid, Ustic

Parent material Alluvium from sandstone & shale, few colluvial stones Close to Cryic in

Physiography Small "Flat" alluvial bottom in narrow canyon The cool bottom position

Relief Gently sloping | Drainage | Salt or alkali

Elevation 7480 | Gr. water | Stoniness

Slope % 10 | Moisture

Aspect West | Root distrib. | % Clay * 20

Erosion In Flood plain | % Coarse fragments * | % Coarser than V.F.S. *

Permeability Mod.

Additional notes

Sample site WHAS-3 for
Co-op mine Taken 8/21/96
Ref. Tests 49146, 49148, 49149, 49150

GROUND COVER (%)	RANGE	AVERAGE
Gravel 2MM-3"		15
Cobble 3-10"		15
Stone 10-24"		15
Boulder >24"		10
Vegetation		10
Litter		30
Bare		5

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	pH Reaction	Boundary	% Rock Fragments	Root Distribution
A1	0-2	Frozen to about 15"	10YR 3/2	SL	WFGR	—	FR	SS* SP	7.0	CW	25G 10C 15S	CF
AC1	2-8		10YR 4/3 + 10YR 4/6	SL	WMGR	—	FR	SS SP	7.2	gw	25G 10C 15S	CFM
AC2	8-24		10YR 4/4 7.5YR 4/4	SL	WMGR-OM	—	FR	SS SP	7.5	gw	30G 15C 8S	CFM
C	24-36#		10YR 4/4 7.5YR 4/4	SL-SCL	OM	SH	FR	SS SP	7.5		35G 15C 10S	

* Very slightly sticky, near SO, PO

SCS-SOILS-232G
REV. 12-70
FILE CODE SOILS-11

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

Soil type Similar to Doney only deeper and very close to coarse-loamy — File No. CW-5

Area Coop Mine, Wildhorse Ridge Portal Proj. Emery Co., Utah — Date 4/2/99 D.LARSEN C.EAST — Stop No. 5

? Classification Fine-loamy, mixed (Calcareous), Frigid Typic Ustorthent or Ustic haplargid

Location Proposed T-soil storage site — S24, T16S, R7E

N. veg. (or crop) Ponderosa pine, Juniper, (few) sagebrush, Saline wildrye — Climate Frigid, Ustic

Parent material Colluvium from Sandstone and shale (& slope wash, local alluvium)

Physiography Slight bench, Toe slope near canyon bottom

Relief Mod. steep	Drainage Well drained	~~Salt or alkali~~
Elevation 7240	Gr. water —	Stoniness
Slope 25-30%	Moisture Moist Throughout profile	
Aspect South	Root distrib. Well distributed to 60 inches	% Clay * 17 At fine-loamy and coarse-loamy break
Erosion moderate	% Coarse fragments *	% Coarser than V.F.S. *
Permeability Moderate		Lab. No.

Additional notes Coop Mine Soil Sample site WHRS-2 of 1996 (49142, 49143, 49144, 49145)
Three large ponderosa pine trees 2½-3 feet in diameter are on this site.
Several old gullies that are healing
Under 4" of soil is frozen
Light snow, 30° aspect

GROUND COVER (%)	RANGE	AVERAGE
Gravel 2MM-3"		15
Cobble 3-10"		10
Stone 10-24"		5
Boulder >24"		2
Vegetation		6
Litter Pine needles & grass		60
Bare		2

Sampled to a greater depth than previous sampling by Co-op mine, pc
Deep ash soil, least stony bench noted in area

* Control section average

Horizon	Depth inches	Color Munsell, dry	Color Munsell, moist	Texture	Structure	Consistence dry	Consistence moist	Consistence wet	Phenolic Reaction	Boundary	% Rock Fragments	Root Distribution		
A	0-6	Grayish Brown 10YR 5/2-4/2	Dark grayish brown 10YR 4/2	FSL-L	WFGR	SO	VFR	SS SP	7.8 ES	GW	5G 5C	MF CM		
AC1	6-20		Brown 10YR 4/3	FSL-L	WFSBK	SO	FR	SS SP	7.8 ES	DW	10G 5C	CFM		
AC2	20-50		Brown 10YR 4/3	FSL	WFSBK	SH	FR	SS SP	8.0 ES	GW	5G 2C	CFM		
C1	50-60		Yellowish Brown To Brown 10YR 5/4 - 4/3	FSL	OM	SH	FR	NS NP	8.0 ES	CW	10G 5C	CFM		
C2	60-73		Yellowish Brown 10YR 5/4	FSL-LFS	OM	SH	VFR	NS NP	8.2 ES		15G 10C	FFM		
	73"	bedrock or larger rock fragment												

SCS-SOILS-232G
REV. 12-70
FILE CODE SOILS-11

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

Soil type Pathead ? - may have a cumbic horizon and ∴ ochrept — File No. CW-6

Area Co-op Mine, Wildhorse Bridge Portal Proj. Emery Co., UT — Date 4/2/99 D. LARSEN C. EAST — Stop No. (2) 6

Classification Loamy-skeletal, mixed (calcareous), frigid Typic Ustorthent or Ustochrept

Location Near west end of conveyor corridor, P-J hill, about 300 feet from west end S24, T16S, R7E

N. veg. (or crop) Pinyon, U. Juniper, curleaf mtn. mahogany, one D-F.fir — Climate Ustic, frigid

Parent material Sandstone and shale, colluvium

Physiography Small lateral ridge, foothill, Descon hill - Top

Relief Convex	Drainage Well drained	Salt or alkali
Elevation 7310	Gr. water —	Stoniness Stony
Slope 15%, slope on sides 60%	Moisture Moist throughout profile	
Aspect South	Root distrib. Restricted at 15 inches	% Clay * 25%
Erosion Mod.	% Coarse fragments * 35 40	% Coarser than V.F.S. *

Permeability Mod - Mod. Slow

Additional notes Co-op Mine sample site for WHAS-1, 49139, 49140, 49141
Extremely stony below 20 inches, but this does not appear to be bedrock
Sandstone rock outcrop up slope 150'
Shale encountered at Top of slope

GROUND COVER (%)	RANGE	AVERAGE
Gravel 2MM-3"		20
Cobble 3-10"		15
Stone 10-24"		13
Boulder >24"		5
Vegetation		7
Litter		20
Bare		20

* Control section average

Horizon	Depth inches	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary	% Rock Fragments	Root Distribution
A1	0-3	10YR 4/2 - 5/2	10YR 3/2	CL	MFGR	SO	VFR	SP	EV	CW	25 G 15 C 5 S	MVF MF
Bw1	3-10	10YR 6/4	10YR 4/6	SCL	MFSBK	SH	FI	SP	EV	gw	10 G 10 C 10 S	CFM
Bw2	10-15	-	10YR 3/4	L-CL	WFSBK	SH	FR	SP	EV	gw	15 G 10 C 10 S	CFMC
C1	15-20	-	10YR 4/4 70% 10YR 5/2 30%	L-CL	OM	H	VFI	SP	EV	gw	30 G 20 C 20 S	VFM
C2	20+ very	high in rock fragments and dense, not practical to dig by hand tools									≥ 70 RF	

SCS-SOILS-232G
REV. 12-70
FILE CODE SOILS-11

SOIL DESCRIPTION

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Soil type Guben — File No. CM-7

Area Co-op Mine, Wildhorse Ridge Portal Proje, Emery Co. UT — Date 4/2/99 D. LARSEN C. EAST — Stop No. 7

Classification Loamy-skeletal, mixed Typic Calciborall

Location Road cut above the portal site — S24, T16S, R7E

N. veg. (or crop) Douglas-fir, curleaf mt. mahogany, pinyon, S. wildrye — Climate Frigid, Ustic

Parent material Colluvium from sandstone and shale

Physiography Canyon sideslope

Relief Very steep — Drainage Well drained — Salt or alkali

Elevation 7900 feet — Gr. water — Stoniness V. stony

Slope 60% — Moisture

Aspect NW — Root distrib. Concentrated in upper 12" — % Clay * 20

Erosion Slight — % Coarse fragments * 45 (Less below, but not restricted) — % Coarser than V.F.S. *

Permeability Moderate

Additional notes Snow storm, windy 230°F

GROUND COVER (%)	RANGE	AVERAGE
Gravel 2MM-3"		
Cobble 3-10"		
Stone 10-24"		
Boulder >24"		
Vegetation		
Litter		
Bare		

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary	% Rock Fragments	Root Distribution
A	0-12	Grayish Brown 10YR 5/2	V. Dark grayish brown 10YR 3/2 - 4/2	Loam	MFGR	SO	VFR	SS SP	es	cw	15 G 15 C 15 S	MVFF
BK1	12-20	10YR 5/2 - 6/2	Brown 10YR 4/3	Loam	WFSBK	SH	VFR	SS SP	ev	gw	15 G 15 C 15 S	CFM
BK2	20-40	Light grayish br. To light gray 10YR 6/2 - 7/2	Grayish brown 10YR 5/2 - 5/3	Loam	WFSBK To OM	SH	FR - FI	SS SP	ev	gw	15 G 15 C 15 S	FFM
BC	40-54		Brown 10YR 4/3	Loam	OM	SH	FI	SS SP	es	gw	15 G 15 C 15 S	FF
C	54+	V. stony a bouldery colluvium			Bedrock	not noted					20 G 20 C 20 S 10 B	

SCS-SOILS-232G
REV. 12-70
FILE CODE SOILS-11

SOIL DESCRIPTION

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Soil type Cabba

File No. CW-8

Area Wild Horse Ridge Portal Project | Date 4/7/99 D. Larsen | Stop No. 8

Classification Loamy, mixed (calcareous), frigid, shallow Typic Ustorthent

Location Lower end of proposed conveyer, near Topsoil storage site S24, T16S, R7E

N. veg. (or crop) P-Juniper | Climate Ustic / Frigid

Parent material Thin colluvium over shale

Physiography Foothills, Toe slope

Relief Steep	Drainage Well drained	Salt or alkali
Elevation 7260	Gr. water —	Stoniness
Slope 40%	Moisture Profile is moist	
Aspect NE	Root distrib.	% Clay *
Erosion Mod.	% Coarse fragments *	% Coarser than V.F.S. *

Permeability slow

Additional notes Notes on TR-4
Surface is cobbly but soil is shallow over shale
Sampled for Lab. analysis

GROUND COVER (%)	RANGE	AVERAGE
Gravel 2MM-3"		25
Cobble 3-10"		15
Stone 10-24"		5
Boulder >24"		5
Vegetation		5
Litter		15
Bare		30

* Control section average

Horizon	Depth inches	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary	% Rock Fragments	Root Distribution
A1	0-4		10YR 3/2	L	MFGR	SO	VFR	S/P		CW	15G	CFM
AC	4-12		10YR 4/2	CL	WFGR WTPL	SH-SO	FR	S/P		GW	45G	CFM
CR	12-18+		2.5Y 4/2 - 10YR 4/1	weathered gray shale having platy rock structure								FF

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL TRANSECT DATA SHEET – NOTES

Page No. 1

Co-op Mine T1 S24, T16S, R7E

County Emery | Soil Mapping Unit PeThead-Cabba Tentatively MV-A

Transect No. T1 | Direction W To E | Boring Interval ± 100' | Length

Starting Location West end of conveyer corridor

Date 4/2/99 | Photo | By D. Larsen

Remarks

T1-1 & 2 are between profile CM-6 on top of P-J hill and the present road, T1-3 & 4 are between CM-6 and CM-5

Profile No. T1-1 Topsoil stony

Percent Slope 60 | Aspect West | Erosion

Position on Slope Side slope

Horizon	Depth (Inches)	Color	Texture	Structure	Consistence	~~Mottles~~	Fragments	Clay Films	pH
A1	0-5	10YR 3/2	SL	WFGR		12 G, 10 C	10 S		
AC	5-10	10YR 4/2	SL	WFGR		Surface rock frag. is			
BC	10-22	10YR 5/4	L	OM		high, less in profile			
C	Shady material mixed with Sandstone Colluvium								

CM-6 2 X

Additional Notes Veg. – Pinyon-Juniper

Between T1-1 & T1-2 Similar To Cabba only Mod. deep & higher rocks

Mod. deep over shale | Series Pathead Fry

Classification L-SK mixed frigid Typic Ustorthent

Profile No. T1-2

Percent Slope 60% | Aspect West | Erosion

Position on Slope Side slope

Horizon	Depth	Color	Texture	Structure	Consistence	~~Mottles~~	Fragments	Clay Films	pH
AC	0-8	10YR 4/2	SL	WFGR		25 G, 10 C	5 S		
C	8-15	10YR 5/4	L	WFGR OM					
C2	very stony								

Additional Notes P-J

Very stony | Series Pathead

Classification Loamy-skeletal, mixed frigid Typic Ustorthent

Profile No. T1-3

Percent Slope 60% | Aspect East | Erosion

Position on Slope

Horizon	Depth	Color	Texture	Structure	Consistence	~~Mottles~~	Fragments	Clay Films	pH
A1	0-3	10YR 3/2	SL	MWGR		25 G, 10 C	5 S		
AC	3-15	10YR 4/4	SL	WFGR		20 G, 10 C	5 S		
C	15-20	10YR 5/4	L	OM		Extremely cobbly			

Additional Notes P-J

EST. surface 35 G, 20 C, 10 S

15% litter, 5% veg, 15% Bare soil | Series Pathead

Classification

CM6

T1 2 3

1

PJ

CM-4 CM-5

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL TRANSECT DATA SHEET

T1
Page No. 2

County Emery Co. | Soil Mapping Unit Tentative A
Transect No. T11 | Direction E-W → E | Boring Interval 2-100' | Length
Starting Location West end of conveyor corridor
Date 4/2/99 | Photo | By D. Larsen
Remarks P-J Foothills

Profile No. T1-4
Percent Slope 40% | Aspect NE | Erosion
Position on Slope Toeslope / Lower 1/3

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH
A1	0-4	10YR 3/2	L	MFGR		15F, 15C,	5%		
AC	4-12	10YR 4/2	CL	WFGR		5F, 5C			
CR	12-18	Weathered	grey	shale					
		Platy	rock	structure					

CW @ 4/9/99

Additional Notes P-J woodland
Shallow over shale

Series Gabba
Classification Loamy, mixed (calcareous), frigid, shallow Typic Ustorthent

Profile No.
Percent Slope | Aspect | Erosion
Position on Slope

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH

Additional Notes

Series
Classification

Profile No.
Percent Slope | Aspect | Erosion
Position on Slope

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH

Additional Notes

Series
Classification

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

T2

SOIL TRANSECT DATA SHEET

T2
Page No. 2

Access road

County Emery | Soil Mapping Unit
Transect No. | Direction | Boring Interval | Length
Starting Location
Date 4/7/99 | Photo | By Dale
Remarks

Profile No. T2-4   170 yds from T2-3 | Surface V. Stony
Percent Slope 45 | Aspect NW | Erosion
Position on Slope Toeslope

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH
A1	0-10	10YR 3/2 M	1			15G 15C	20 S		
AC	10-20	10YR 4/3	1			20G 15C	10 S		
weak Bk	20-32	10YR 4/4.5	1			"			
C						"			
	Boulders ≈ 10%								

Additional Notes
Photo 8 - up road, boulders on left
Road & conveyor together here | Series Datino on cut
Classification

Profile No. T2-5 on cut slope | Looks like some washing from road runoff
Percent Slope 75% | Aspect NW | Erosion Severe
Position on Slope Toeslope

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH
A1	0-8	10YR 3/2 4/2	sl	WFGR	NS NP	15 20	15		
AC	8-32	10YR 4/2	sl	WFGR	NS NP	"			
CA	32+	10YR 4/4	sl	OM	NS NP	"			
SAMPLED	COMPOSITE	5-30" layer							

CW-9

Additional Notes Some sidecast material on slope from road above
Photos 7 & 6
near drainage crossing on road before switch back | Series Mixed / Datino ?
Classification

Profile No. T2-6
Percent Slope ≈ 10% ≈ 60-65% | Aspect W | Erosion
Position on Slope Drainage bottom & Toeslope

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH

Very bouldery drainage bottom
(Alluvial and colluvial materials
DF on N facing slope
Rock outcrop on South facing slope (P-J)
V stony sandy loam
Similar to T2-5 on Toeslope & road

Additional Notes Photo 5 Looking up stream, conveyor route and road on right
Photo 4 - P-J slope & R.O. N side | Series
Classification

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL TRANSECT DATA SHEET

T2
Page No. 3

County | Soil Mapping Unit: Access road
Transect No. | Direction | Boring Interval | Length
Starting Location
Date | Photo | By
Remarks

Profile No. T2-7
Percent Slope 70% | Aspect N pf, p-v | Erosion
Position on Slope

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH

Note: Cut slope has a short section of moderately deep loamy soil over shale. It is mostly very deep alluvium. V stony & cobbly sl. Some calcium carbonate but doesn't appear to be enough for a calcic horizon. Also some side-cast material across the slope.

Additional Notes
Drainage bottom very bouldery

Series: Datino
: Darey 30' section

Classification

Profile No. T2-8
Percent Slope 65% | Aspect N | Erosion
Position on Slope

Horizon	Depth	Color EST.	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH
O	1-0								
A1	0-6	10YR 3/2	l	WFGR	SO VFR ss so	10GR, 10C	30S		
A2	6-12	10YR 4/2	l-	WFGR	SO VFR ss sp	"			
BK1	12-21	10YR 4/4-5/4	SiL	"	SH FR, ss sl	15G 20C	5S		
BK2	21-32	10YR 5/4	sl	on		20G 20C	10S		
BK3	32-45	10YR 5/4	sl	more carbonates (staining to ...)		"			

Additional Notes
Large boulders just up slope
Photo 3

Series: Gubon

Classification

Profile No. T2-9
Percent Slope 80% | Aspect South east | Erosion
Position on Slope: Toe slope

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH

Shallow and moderately deep over shale.
Similar to soil pit CW-3

Additional Notes
Photo 2 Cut at switch back, at drainage crossing, north side
Sandstone rock outcrop over shale

Series: Darey
- Cabba

Classification

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL TRANSECT DATA SHEET

Page No. 4

Along access road

County | Soil Mapping Unit

Transect No. | Direction | Boring Interval | Length

Starting Location

Date 4/7/99 | Photo | By

Remarks

Profile No. T2-10

Percent Slope 80% | Aspect NW | Erosion slumpy slight

Position on Slope Lower 1/3

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH
About a 70 foot section of A slope shows water seepage and shallow slumping (shows failure) CL soils / SS shale similar to Dancy but wetter 4'+ (not bedrock)									
Most of the road cut shows Cumulic and Ochric - like soils - Questionable mollic - look: Ochric on about 40% of the soils - Calcic is weak - Some Durinodic soils too									

Additional Notes About 300' above stream crossing

EST. about 10% has slight within 10' of surface

At NRCS soil unit break - Food inclusion

Series

Classification

Profile No. T2-11

Percent Slope 60% | Aspect NW | Erosion

Position on Slope

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH
This section of slope has mostly very deep, well drained evidently stony colluvium									
Surface is mostly Too light for a mollic									
No calcic									
Fragment section (40%) bedrock is 1-4 ft from the surface									

Additional Notes About 200' from first switchback on North-facing slope

Some bristle cone pines present + Pinyon Few D.F - mosses

Series

Classification 1-SK. T. UsTorthent, redsp

Profile No. TR-12

Percent Slope 70% 8°↓ | Aspect NW | Erosion | Pinyon, Bristlecone pine D-Fir

Position on Slope Mid slope

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH
Bedrock and large boulders with pockets of very stony colluvium									

Additional Notes

Series

Classification

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL TRANSECT DATA SHEET

County | Soil Mapping Unit: Along access road
Transect No. T2 | Direction Varies | Boring Interval | Length
Starting Location
Date | Photo | By
Remarks

Profile No. T2-13
Percent Slope 70% | Aspect N | Erosion
Position on Slope Midslope at edge of slight dissection

Horizon	Depth	Color m	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH
O	1-0		l						
A	0-2	10YR 4/2	l	WFGR		15G, 10G	40S		
AC	2-8	10YR 4/4	l	WFSB			5B		
BK	8-24	10YR 5/4	l	Cm					
or C	boulders + stones in colluvium					10G, 10C	20S 40B		

Additional Notes Roots limited to about 24'
Photo Take of road cut; stony bouldery colluvium over thin coal, shale and sandstone
Series
Classification l-sk, T. Ustochrept ? Ustochrept

Profile No. T2-14 (Below in cut behind 3-14)
Percent Slope 70 | Aspect NW | Erosion: Pinyon serviceberry D. Fir
Position on Slope Midslope

Horizon	Depth	m Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH
A1	0-12	10YR 3/2-4/2	sl	2MGR		Mixed Gr - B			
AB	12-16	10YR 4/2	l	W1SBK		60% RF			
BK+	16-36	10YR 5/3	l	OM	VH VFI				
C	36+		sl-l	OM	VH VFI				
	To at least 12'								
+	marginal to calcic								

Additional Notes Near switchback at upper level access to portal
Series Fruita ? Detrita
Classification l-sk mixed Typic Calciborollic Haplaborolls (Aridic sic cc)

Profile No. T2-15
Percent Slope 60 | Aspect NW | Erosion D. Fir, pinyon, mtn. mahogany
Position on Slope Midslope

Horizon	Depth	Color	Texture	Structure	Consistence	Mottles	Fragments	Clay Films	pH
Similar to T2-14									

CW-10 Sample

Additional Notes 20-30 Sampled for Calcic
CW-10
Series Cuhow (Weak mollic)
Classification

APPENDIX D

SOIL AND LANDSCAPE PHOTOGRAPHS
WILD HORSE RIDGE PORTAL PROJECT

(Photographs were taken on April 1, 2, and 7, 1999.)
Original photos were 4 X 7 inches. Distortion has occurred in format for page layout on some of the photos.

WILD HORSE RIDGE PORTAL PROJECT
BEAR CANYON MINE

Soil Profile CW-1 and photo of the slope below the road at the portal site.

Side cast material on a north-facing slope. the original surface is at a depth of about three feet.

Tape measure units are in feet.

WILD HORSE RIDGE PORTAL PROJECT
BEAR CANYON MINE

Soil Profile CW-2 and surface conditions on the south-facing slope near the portal site. A Pathead soil in Soil Map Unit G.

Note sandstone rock crop near top of photo above.

Appendix D-2

WILD HORSE RIDGE PORTAL PROJECT
BEAR CANYON MINE

Soil Profile CW-3 and surface conditions. Toe of a south-facing slope about 800 feet below the portal site along the conveyor corridor.

A moderately deep soil (Doney) over shale in Map Unit G.

Appendix D-3

WILD HORSE RIDGE PORTAL PROJECT
BEAR CANYON MINE

Lower photo shows the site of Soil Profile CW-4 an soil sampling site WHRS-3 in Soil Map Unit C, about 600 feet down the canyon from the portal site.

The upper photo is looking down the drainage from the portal site. The drainage is cut to bedrock.

WILD HORSE RIDGE PORTAL PROJECT
BEAR CANYON MINE

Soil Profile CW-5 in Soil Map Unit D.

Soil Sampling site WHRS-2 by Co-op Mining Company.

Deep soils on a slight bench on a toeslope. This site has been proposed as a topsoil storage area.

Appendix D-5

WILD HORSE RIDGE PORTAL PROJECT
BEAR CANYON MINE

Soil Profile CW-6 and landscape features along the west end of the conveyor corridor.

A Pathead soil in Soil Map Unit A.

Appendix D-6

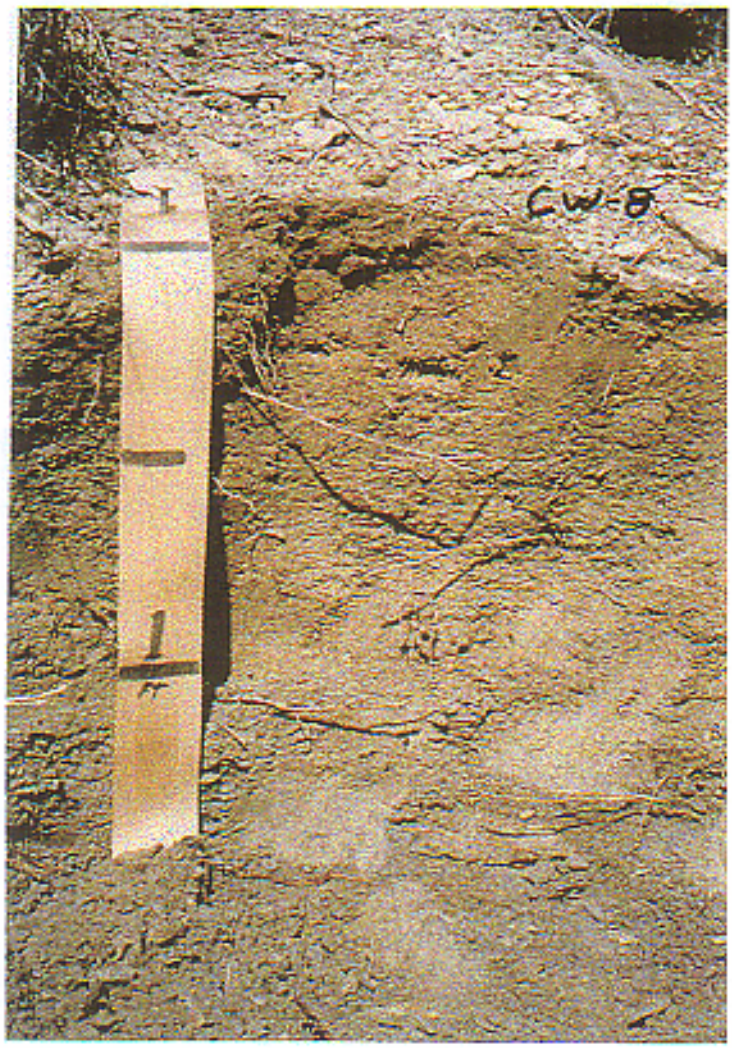
WILD HORSE RIDGE PORTAL PROJECT
BEAR CANYON MINE

Soil Profile SW-7 site on road cut above the portal location.

A Guben soil in Soil Map Unit E.

Appendix D-7

WILD HORSE RIDGE PORTAL PROJECT
BEAR CANYON MINE



Soil Profile CW-8 and surface conditions in Soil Map Unit A.

This is a shallow soil over shale (Cabba).

Appendix D-8

WILD HORSE RIDGE PORTAL PROJECT
BEAR CANYON MINE

Soil Sampling Site CW-9 at the toe of a north-facing slope in Soil Map Unit E.

Corresponds with transect data sheet T2-5

Appendix D-9

WILD HORSE RIDGE PORTAL PROJECT
BEAR CANYON MINE

Examples of roadcuts on the north-facing slopes showing very stony colluvium and shale.

Top photo corresponds to transect data point T2-13 and the lower photo is at T2-2 and T2-3

APPENDIX E

SOIL SERIES AND FAMILY DESCRIPTIONS (TAXONOMIC UNITS)

FROM: Soil Survey of Carbon Area, Utah,
USDA, Natural Resources Conservation Service

Cabba Family

The Cabba family consists of shallow, well drained, moderately permeable soils on benches, canyon rims, and steep canyonsides. These soils formed in residuum and colluvium derived dominantly from shale or siltstone of the Green River Formation. Slope is 3 to 70 percent. Elevation is 5,000 to 8,200 feet. Average annual precipitation ranges from 12 to 16 inches, and average annual air temperature ranges from 42 to 45 degrees F.

These soils are loamy, mixed (calcareous), frigid, shallow Typic Ustorthents.

Reference pedon of a Cabba family bouldery loam in an area of Cabba family-Guben-Rock outcrop complex, on the slopes of Cottonwood Ridge, about 250 feet west and 1,500 feet north of the southeast corner of sec. 7, T. 13 S., R. 16 E.

A1—0 to 3 inches; pale brown (10YR 6/3) bouldery loam, brown (10YR 4/3) moist; moderate medium granular structure parting to moderate fine granular; loose, slightly sticky and slightly plastic; common very fine and fine roots; 5 percent pebbles, 10 percent cobbles, and 15 percent boulders; slightly calcareous; disseminated calcium carbonate; mildly alkaline (pH 7.8); abrupt smooth boundary.

C1—3 to 7 inches; brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak fine granular structure; loose, slightly sticky and slightly plastic; common very fine and fine roots; slightly calcareous; mildly alkaline (pH 7.8); abrupt smooth boundary.

C2—7 to 15 inches; light yellowish brown (10YR 6/4) loam, yellowish brown (10YR 5/4) moist; massive; soft, friable, slightly sticky and slightly plastic; common very fine and fine roots; slightly calcareous; moderately alkaline (pH 8.3); abrupt smooth boundary.

C3r—15 inches; rippable shale; soft carbonate coatings on surface of rock.

Paralithic contact is at a depth of 8 to 20 inches.

A horizon: Hue is 10YR or 5Y, and value is 4 or 5 when moist. Texture is gravelly loam, bouldery loam, or extremely channery loam.

C horizon: Hue is 10YR or 2.5Y, value is 5 or 6 when dry, and chroma is 2 to 4. Texture is loam, gravelly loam, or clay loam. Clay content is 20 to 35 percent. Rock fragment content is 0 to 30 percent.

Datino Series

The Datino Series consists of very deep, well drained, moderately permeable soils on canyonsides and mountain slopes. These soils formed in colluvium derived dominantly from sandstone and shale. Slope is 15 to 80 percent. Elevation is 6,800 to 8,700 feet. Average annual precipitation ranges from 16 to 20 inches, and average annual air temperature ranges from 38 to 45 degrees F.

These soils are loamy-skeletal, mixed Typic Haploborolls.

Typical pedon of a Datino extremely stony fine sandy loam in an area of Perma family-Datino complex, about 0.25 mile south of Soldier Creek Mine, 2,400 feet west and 2,200 feet south of the northeast corner of sec. 18, T. 13 S., R. 12 E.

A1—0 to 10 inches; brown (10YR 4/3) extremely stony fine sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; common very fine and fine roots and few medium and coarse roots; few very fine pores; 15 percent pebbles, 25 percent cobbles, and 25 percent stones; moderately alkaline (pH 7.9); clear smooth boundary.

B2—10 to 16 inches; brown (10YR 5/3) very stony loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine, fine, medium, and coarse roots; common very fine and fine pores and few medium pores; 15 percent pebbles, 15 percent cobbles, and 10 percent stones; slightly calcareous; moderately alkaline (pH 7.9); gradual wavy boundary.

C1ca—16 to 41 inches; pale brown (10YR 6/3) very stony fine sandy loam, brown (10YR 5/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine, fine, medium, and coarse roots; common very fine and fine pores; 15 percent pebbles, 20 percent cobbles, and 25 percent stones; strongly calcareous; soft powdery masses of calcium carbonate; moderately alkaline (pH 8.0); gradual smooth boundary.

C2—41 to 60 inches; pale brown (10YR 6/3) very stony fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine, fine, medium, and coarse roots; few very fine pores; 15 percent pebbles, 20 percent cobbles, and 25 percent stones; moderately calcareous; disseminated calcium carbonate; moderately alkaline (pH 7.9).

Secondary calcium carbonate is at a depth of 15 to 22 inches. The mollic epipedon is 10 to 15 inches thick. The solum is 15 to 22 inches thick. The particle-size control section is 35 to 60 percent rock fragments.

A horizon: Value is 4 or 5 when dry and 2 or 3 when moist, and chroma is 2 or 3.

B2 horizon: Value is 3 to 5 when dry and 2 to 4 when moist, and chroma is 2 or 3. Clay content is 18 to 26 percent. Rock fragment content is 35 to 45 percent. Reaction is mildly alkaline or moderately alkaline.

C horizon: Value is 5 or 6 when dry, and chroma is 2 or 3. Clay content is 16 to 25 percent. Rock fragment content is 40 to 70 percent. Reaction is mildly alkaline or moderately alkaline.

Doney Family

The Doney family consists of moderately deep, well drained, moderately permeable soils on benches, foot slopes, and mountain slopes. These soils formed in residuum and colluvium derived dominantly from siltstone, shale, and sandstone. Slope is 3 to 70 percent. Elevation is 6,700 to 9,500 feet. Average annual precipitation ranges from 14 to 20 inches, and average annual air temperature ranges from 38 to 45 degrees F.

These soils are fine-loamy, mixed, frigid Typic Ustochrepts.

Reference pedon of a Doney family stony loam in an area of Rabbitex-Doney family-Midfork family complex, about 7.5 miles northwest of Helper, 800 feet south and 1,800 feet east of the northwest corner of sec. 19, T. 12 S., R. 9 E.

A1—0 to 4 inches; brown (10YR 5/3) stony loam, dark brown (10YR 3/3) moist; weak medium platy structure parting to moderate medium granular; soft, friable; common very fine and fine roots; few very fine pores; 10 percent pebbles, 5 percent cobbles, and 5 percent stones; slightly calcareous; disseminated calcium carbonate; moderately alkaline (pH 8.4); abrupt smooth boundary.

B21—4 to 11 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, firm, sticky and plastic; few very fine and common fine roots; few very fine pores; 5 percent pebbles and 5 percent cobbles; slightly calcareous; disseminated calcium carbonate; moderately alkaline (pH 8.4); gradual smooth boundary.

B22—11 to 15 inches; pale brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; few very fine and fine roots; few very fine and fine pores; 10 percent pebbles; moderately calcareous; disseminated calcium carbonate; strongly alkaline (pH 8.6); gradual smooth boundary.

C1—15 to 24 inches; light gray (2.5Y 7/2) loam, light olive brown (2.5Y 5/4) moist; massive; loose, very friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine pores; 10 percent pebbles; strongly calcareous; disseminated calcium carbonate; strongly alkaline (pH 8.8); clear smooth boundary.

C2—24 to 35 inches; light gray (2.5Y 7/2) loam, light olive brown (2.5Y 5/4) moist; massive; loose, very friable, slightly sticky; few fine roots; few very fine pores; 15 percent pebbles; strongly calcareous; disseminated calcium carbonate; strongly alkaline (pH 9.0); gradual smooth boundary.

C3r—35 inches; weathered shale.

Paralithic contact is at a depth of 20 to 40 inches. The particle-size control section is 0 to 15 percent rock fragments.

A1 horizon: Hue is 10YR or 2.5Y, value is 5 or 6 when dry, and chroma is 2 or 3. Texture is gravelly sandy loam, silt loam, and stony loam. Clay content is 15 to 22 percent.

B horizon: Hue is 10YR or 2.5Y, value is 5 to 7 when dry and 4 to 6 when moist, and chroma is 2 or 3. Texture is loam or clay loam. Clay content is 18 to 30 percent.

C horizon: Hue is 10YR or 2.5Y, value is 6 or 7 when dry and 5 or 6 when moist, and chroma is 2 or 3. Texture is loam or clay loam.

Guben Series

The Guben series consists of very deep, well drained, moderately permeable soils on canyonsides and mountain slopes. These soils formed in colluvium derived dominantly from sandstone and shale. Slope is 15 to 75 percent. Elevation is 5,000 to 9,500 feet. Average annual precipitation ranges from 14 to 20 inches, and average annual air temperature ranges from 38 to 45 degrees F.

These soils are loamy-skeletal, mixed Typic Calciborolls.

Typical pedon of Guben extremely bouldery loam in an area of Cabba family-Guben-Rock outcrop complex, in Prickly Pear Canyon, about 1,200 feet south and 2,000 feet east of the northwest corner of sec. 14, T. 12 S., R. 15 E.

O1—0.5 inch to 0; pine needles and grasses.

A1—0 to 7 inches; grayish brown (10YR 5/2) extremely bouldery loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine, fine, medium, and coarse roots; 15 percent pebbles, 10 percent cobbles, 5 percent stones, and 10 percent boulders; moderately calcareous; disseminated calcium carbonate; moderately alkaline (pH 8.2); clear wavy boundary.

B2—7 to 15 inches; pale brown (10YR 6/3) very stony loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine, fine, medium, and coarse roots; 10 percent pebbles, 15 percent cobbles, and 20 percent stones; moderately calcareous; disseminated calcium carbonate; moderately alkaline (pH 8.4); clear wavy boundary.

C1ca—15 to 30 inches; very pale brown (10YR 7/3) very stony loam, pale brown (10YR 6/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots and few fine, medium, and coarse roots; few very fine and fine pores; 10 percent pebbles, 20 percent cobbles, 20 percent stones, and 5 percent boulders; strongly calcareous; disseminated calcium carbonate; strongly alkaline (pH 8.6); clear smooth boundary.

C2—30 to 60 inches; light yellowish brown (10YR 6/4) very stony loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; few very fine and medium pores and common fine pores; 10 percent pebbles, 20 percent cobbles, 25 percent stones, and 5 percent boulders; moderately calcareous; disseminated calcium carbonate; strongly alkaline (pH 9.0).

The mollic epipedon is 7 to 10 inches thick. The solum is 15 to 24 inches thick. The particle-size control section is 35 to 60 percent rock fragments. Secondary calcium carbonate is at a depth of 11 to 24 inches.

A horizon: Value is 4 or 5 when dry, and chroma is 2 or 3. Texture is extremely bouldery loam, extremely stony loam, or extremely bouldery fine sandy loam. Reaction is mildly alkaline or moderately alkaline. Calcium carbonate equivalent is 11 to 19 percent.

B horizon: Hue is 10YR or 7.5YR, value is 5 or 6 when dry and 3 or 4 when moist, and chroma is 2 to 4. Texture is very stony loam or very cobbly loam. Clay content is 17 to 22 percent. Rock fragment content is 35 to 55 percent. Reaction is mildly alkaline or moderately alkaline. Calcium carbonate equivalent is 20 to 25 percent.

Cca horizon: Hue is 7.5YR or 10YR, value is 6 or 7 when dry and 5 or 6 when moist, and chroma is 2 to 4. Texture is very stony loam or very cobbly fine sandy loam. Clay content is 17 to 25 percent. Rock fragment content is 35 to 60 percent. Reaction is moderately alkaline or strongly alkaline. Calcium carbonate equivalent is 20 to 38 percent.

C horizon: Texture is very stony loam or very cobbly fine sandy loam. Clay content is 17 to 24 percent. Reaction is moderately alkaline or strongly alkaline. Calcium carbonate equivalent is 19 to 30 percent.

Pathead Series

The Pathead series consists of moderately deep, well drained, moderately permeable soils on benches, ridges, canyonsides, and mountain slopes. These soils formed in colluvium and residuum derived dominantly from sandstone and shale. Slope is 15 to 70 percent. Elevation is 5,900 to 9,000 feet. Average annual precipitation is 14 to 20 inches, and average annual air temperature is 38 to 45 degrees F.

These soils are loamy-skeletal, mixed (calcareous), frigid Typic Ustorthents.

Typical pedon of a Pathead extremely stony loam in an area of Pathead-Curecanti family association, about 2 miles north and 4 miles west of Helper, about 1,100 feet north and 400 feet west of the southeast corner of sec. 6, T. 13 S., R. 9 E.

A1—0 to 3 inches; brown (10YR 5/3) extremely stony loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; few very fine pores; 5 percent pebbles, 15 percent cobbles, 40 percent stones, and 5 percent boulders; moderately calcareous; disseminated calcium carbonate; strongly alkaline (pH 8.6); abrupt smooth boundary.

C1—3 to 14 inches; pale brown (10YR 6/3) very cobbly loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots and few fine and medium roots; many very fine pores; 20 percent pebbles and 5 percent cobbles; moderately calcareous; disseminated calcium carbonate; strongly alkaline (pH 8.8); clear smooth boundary.

C2—14 to 26 inches; pale brown (10YR 6/3) very cobbly loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; soft, friable, slightly sticky and slightly plastic; common very fine and few fine roots; few very fine pores; 20 percent pebbles, 25 percent cobbles, and 5 percent stones; moderately calcareous; disseminated calcium carbonate; strongly alkaline (pH 8.8); clear smooth boundary.

R—26 inches; sandstone.

Bedrock is at a depth of 20 to 40 inches. The particle-size control section is 35 to 60 percent rock fragments.

A horizon: Value is 5 or 6 when dry and 3 to 5 when moist, and chroma is 2 or 3. Texture is gravelly loam, cobbly loam, extremely stony fine sandy loam, extremely stony loam, or extremely bouldery fine sandy loam. Reaction is moderately alkaline or strongly alkaline.

C horizon: Hue is 10YR or 2.5Y, value is 6 or 7 when dry and 3 to 5 when moist, and chroma is 2 to 4. Texture is very cobbly loam, extremely cobbly loam, or very stony fine sandy loam. Clay content is 18 to 27 percent. Calcium carbonate equivalent is 11 to 28 percent. Reaction is moderately alkaline or strongly alkaline.

Podo Series

The Podo series consists of shallow, well drained, moderately rapidly permeable soils on benches, mesas, and mountain slopes. These soils formed in residuum and colluvium derived from sandstone, shale, and limestone. Slope is 1 to 70 percent. Elevation is 5,200 to 9,000 feet. Average annual precipitation is 14 to 20 inches, and average annual air temperature is 38 to 45 degrees F.

These soils are loamy, mixed (calcareous), frigid Lithic Ustorthents.

Typical pedon of Podo gravelly sandy loam, 1 to 8 percent slopes, about 26 miles northeast of Sunnyside, about 2,300 feet west and 50 feet south of the northeast corner of sec. 19, T. 12 S., R. 17 E.

A1—0 to 2 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) moist; weak medium platy structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine and fine vesicular pores; 20 percent pebbles; moderately calcareous; moderately alkaline (pH 8.2); abrupt wavy boundary.

C1—2 to 8 inches; brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; few very fine and fine pores; 10 percent pebbles; strongly calcareous; moderately alkaline (pH 8.2); clear wavy boundary.

C2—8 to 11 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) moist; massive; soft, friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; 25 percent pebbles; strongly calcareous; moderately alkaline (pH 8.2); abrupt smooth boundary.

R—11 inches; sandstone.

Bedrock is at a depth of 8 to 20 inches.

A1 horizon: Hue is 7.5YR or 10YR, value is 5 or 6 when dry and 3 to 5 when moist, and chroma is 2 to 4. Texture is gravelly sandy loam, gravelly loam, cobbly loam, very stony loam, or very bouldery sandy loam. Calcium carbonate equivalent is 12 to 15 percent.

C horizon: Hue is 7.5YR or 10YR, value is 5 or 6 when dry and 4 or 5 when moist, and chroma is 2 to 4. Texture is gravelly sandy loam, loam, or gravelly loam. Clay content is 13 to 27 percent. Rock fragment content is 5 to 35 percent. Calcium carbonate equivalent is 22 to 33 percent.

Winetti Series

The Winetti series consists of very deep, well drained, moderately rapidly permeable soils on narrow valley and canyon floors. These soils formed in alluvium derived from sandstone and shale. Slope is 1 to 8 percent. Elevation is 4,600 to 7,200 feet but commonly is 5,200 to 6,400 feet. Average annual precipitation is 12 to 16 inches, and average annual air temperature is 43 to 45 degrees F.

These soils are loamy-skeletal, mixed (calcareous), frigid Typic Ustifluvents.

Typical pedon of a Winetti bouldery sandy loam in an area of Shupert-Winetti complex, about 2.5 miles north of Sunnyside Mine, about 1,800 feet south and 2,500 feet west of the northeast corner of sec. 20, T. 14 S., R. 14 E.

A1—0 to 6 inches; grayish brown (10YR 5/2) bouldery sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; soft, very friable; common very fine, fine, and medium roots and few coarse roots; 4 percent cobbles, 15 percent stones, and 10 percent boulders; slightly calcareous; disseminated calcium carbonate; mildly alkaline (pH 7.6); abrupt smooth boundary.

C1—6 to 11 inches; pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine, fine, and medium roots; common fine pores; 10 percent pebbles; strongly calcareous; disseminated calcium carbonate; moderately alkaline (pH 8.2); clear wavy boundary.

C2—11 to 26 inches; pale brown (10YR 6/3) very bouldery loam, brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common fine pores; 10 percent pebbles, 5 percent cobbles, 10 percent stones, and 15 percent boulders; strongly calcareous; coatings of calcium carbonate on the underside of rock fragments; moderately alkaline (pH 8.4); abrupt smooth boundary.

C3—26 to 34 inches; brown (10YR 5/3) very bouldery loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common fine pores; 10 percent pebbles, 5 percent cobbles, 10 percent stones, and 15 percent boulders; strongly calcareous; coatings of calcium carbonate on the underside of rock fragments; moderately alkaline (pH 8.4); abrupt smooth boundary.

C4—34 to 60 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 5/3) moist; single grain; loose, very friable, slightly sticky; few very fine and fine roots; 40 percent pebbles, 5 percent cobbles, and 5 percent boulders; strongly calcareous; coatings of calcium carbonate on the underside of rock fragments; moderately alkaline (pH 8.4).

The particle-size control section is 35 to 50 percent rock fragments.

C horizon: Value is 5 or 6 when dry and 4 or 5 when moist, and chroma is 2 or 3. Texture is mainly very bouldery loam or very gravelly sandy loam, but there are thin layers of very bouldery sandy clay loam in some pedons. Clay content is 14 to 17 percent.

APPENDIX F

COMPARISON OF SOIL SURVEY MAP UNITS

BEAR CANYON MINE
WILD HORSE RIDGE PORTAL PROJECT

BEAR CANYON MINE
WILD HORSE RIDGE PORTAL PROJECT

DETAILED SOIL MAP UNITS COMPARED TO NRCS ORDER 2 MAPPING

DETAILED MAP UNIT SYMBOL	
A	This map unit was in an area originally mapped as UMF2 (Guben-Rabbitex-Pathead Complex, 10 to 50 percent slopes). Soils found in the area mapped as unit A were dominantly Pathead and Cabba.
B	This map unit was part of an area mapped as C107 (Shupert-Winetti Complex, 1 to 8 percent slopes.) The project area is at a higher elevation then is typical of C107. Soils are strongly influenced by colluvium; with very little typical alluvial bottom land soils. Slopes are steeper in the map unit then identification C107. C107 was mapped higher on the adjacent side slopes than in this detailed section.
C	This unit was part of C107. It is at too high of an elevation for the Shupert-Winetti Complex and has steeper slopes and rock outcrop present.
D	This unit was part of C107. The elevation is too high for the Shupert-Winetti Complex and the slope is steeper. It is more of a toeslope position than a bottom land.
E	This unit was mapped within units C107 (Shupert-Winetti Complex) and DHG2 (Commodore-Datino Variant complex, 40 to 60 percent slopes). Map unit C107 is not appropriate due to very steep slopes, colluvial soils, and cooler temperatures. The shallow Commodore soils were not noted at this toeslope position. Soils are mostly formed from deep, very stony colluvial deposits with some shale present.

F This unit was mapped as UMF2 (Guben-Rabbitex-Pathead Complex, 10 to 50 percent slopes). The area mapped as F has steeper slopes than UMF2 and is dominated by very stony soils and sandstone bedrock.

G This soil map unit was originally mapped as UFF2 (Doney-Cabba-Podo Complex, 20 to 60 percent slopes). The map unit components remain the same, however, the slope gradient was increased to 80 percent for Unit G.

MAP A

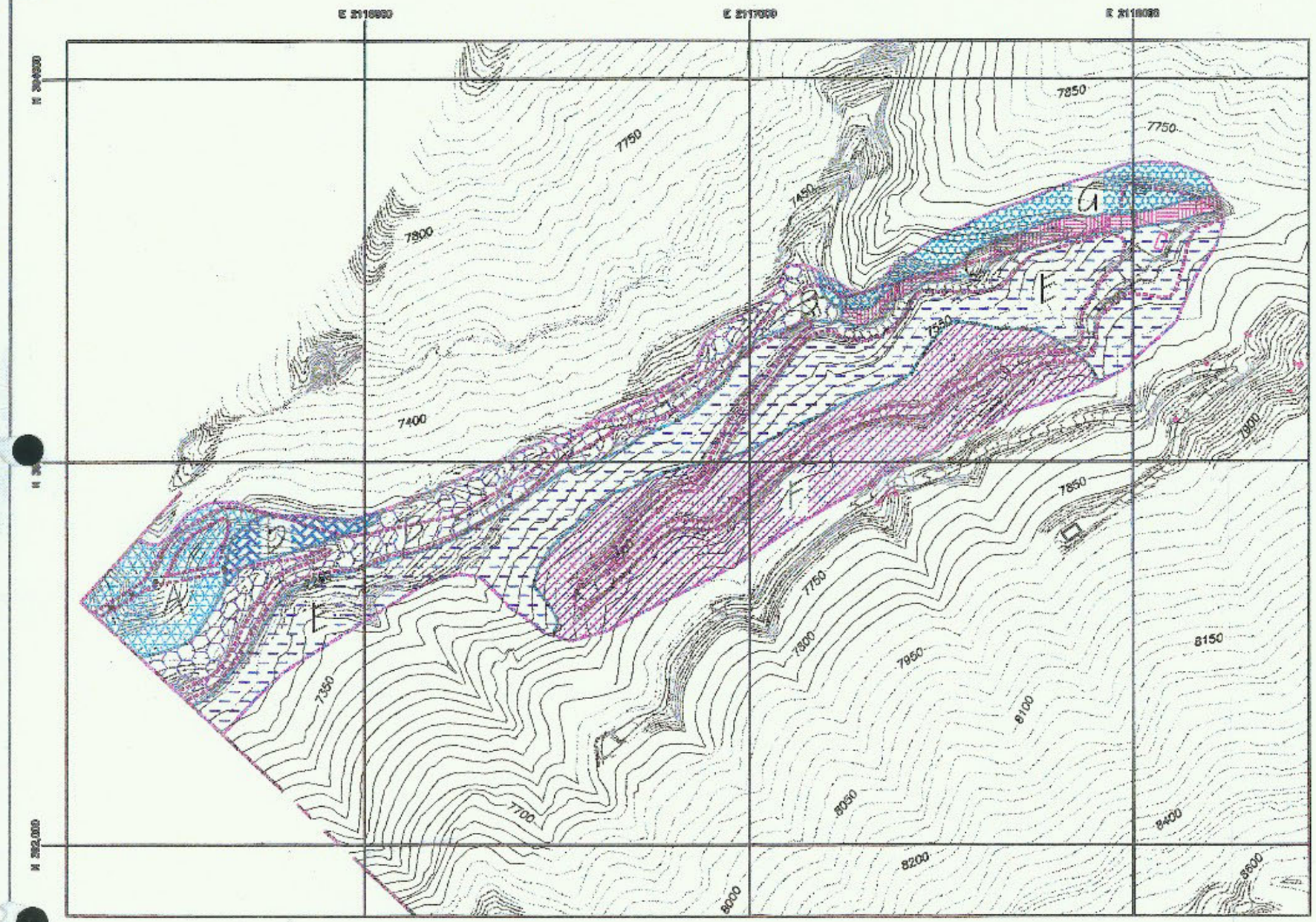
DETAILED SOIL SURVEY MAP

BEAR CANYON MINE
WILD HORSE RIDGE PORTAL PROJECT

DETAILED SOIL SURVEY MAP
MAP A

BEAR CANYON MINE

Wild Horse Ridge Portal Project



LEGEND:

- A: Pathead - Cabba Complex, 30 to 70% slopes
- B: Winetti, High Elevation, 5 to 30% slopes
- C: Winetti, High Elevation - Rock Outcrop, 10 to 30% slopes
- D: Doney, Deep, 10 to 30% slopes
- E: Datino - Cuben Complex, 30 to 80% slopes
- F: Cuben - Pathead Complex, 30 to 80% slopes
- G: Doney - Cabba - Padlo Complex, 30 to 80% slopes

Soil Survey Project Boundry
Soil Map Unit Boundry
Proposed Disturbed Area Boundry

N

SCALE 1"= 200'

200' 100' 0' 200' 400' 600'

CONTOUR INTERVAL 5'

PHOTOGRAPHY DATE SEP 3, 1991 & OCT 20, 1995

CLIENT: C.W. MINING

VIEWING TERMS: [illegible] and the information therein may not be distributed or reproduced without the knowledge and consent of E.I.S.

DATE: MAY 1999

SCALE: AS SHOWN

ACAD REF: Emery / C.W. Mining / Bear Canyon / MapA

DESIGNED BY:

EIS

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Soil Information Provided by Ron Larsen, Price
Base map provided by C.W. Mining

MAP B

SOIL DATA COLLECTION MAP

BEAR CANYON MINE
WILD HORSE RIDGE PORTAL PROJECT

N

SCALE: 1 inch = 200 feet

MAP B
SOIL DATA COLLECTION MAP

BEAR CANYON MINE
WILD HORSE RIDGE PORTAL PROJECT

O	CW-1	Soil Pedon Descriptions
•	T1-1	Transect Data Points
	WHRS	CO-OP Mining Co. Soil Sample Sites (1996)

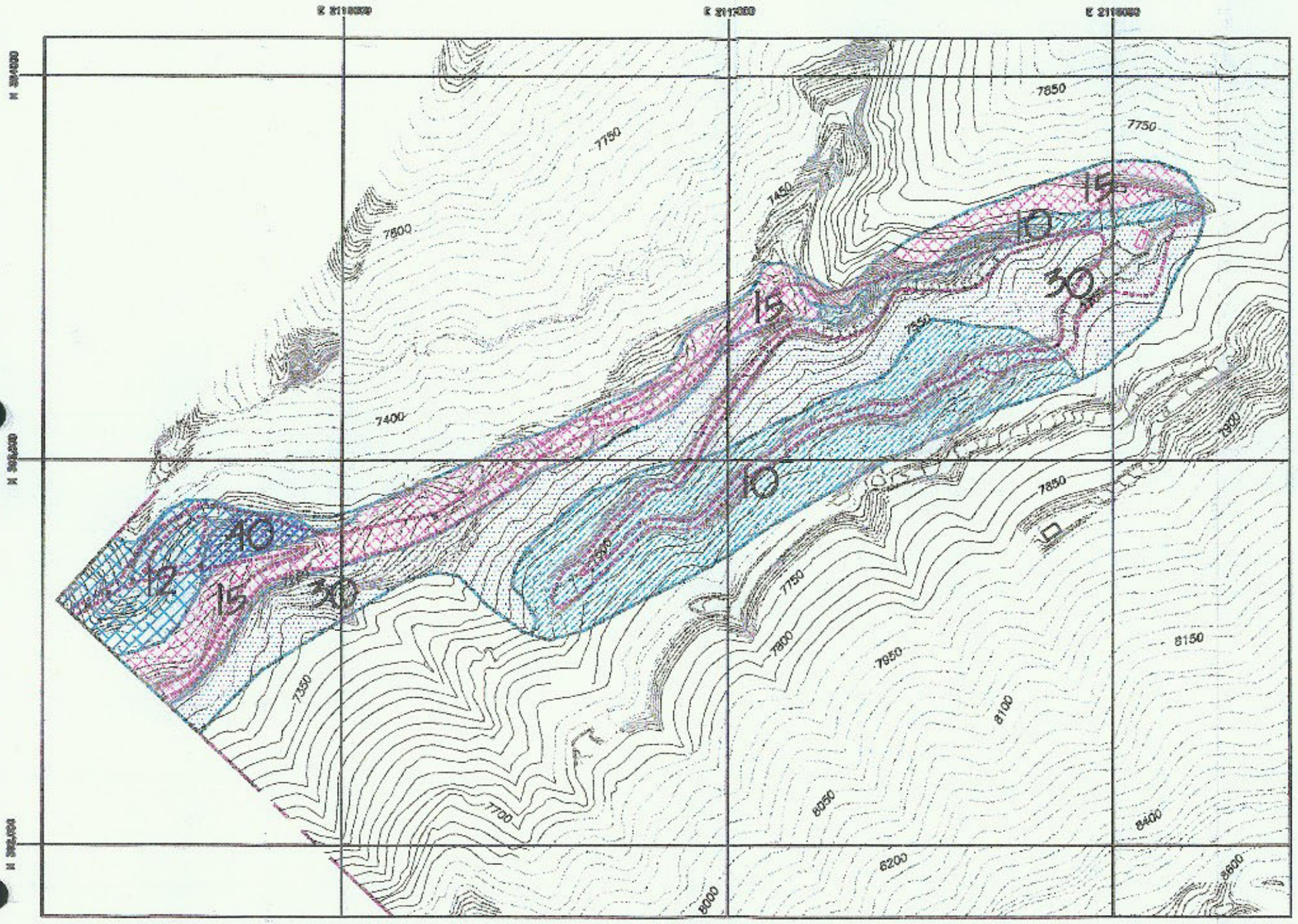
4/99 D.C.

MAP C

SOIL SUITABILITY MAP

BEAR CANYON MINE
WILD HORSE RIDGE PORTAL PROJECT

SOIL SUITABILITY MAP
MAP C
BEAR CANYON MINE
Wild Horse Portal Project



LEGEND:

Soil Survey Project Boundry
Soil Map Unit Boundry
Proposed Disturbed Area Boundry

APROXIMATE THICKNESS OF SALVAGEABLE SOIL
(Units Given in Inches)

10" 15" 40"
12" 30"

(Excludes Existing Road)

N

SCALE 1"= 200'
200' 100' 0' 200' 400' 600'
CONTOUR INTERVAL 5'
PHOTOGRAPHY DATE SEP 3, 1991 & OCT 20, 1995

CLIENT: C.W. MINING

VIEWING TERMS: [illegible]

DATE: MAY 1999

SCALE: AS SHOWN

ACAD REF: Enters/ C.W. Mining/ Bear Canyon/ Map C

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